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Vol. 13, No. 12
June 30, 1988

Energy Research Abstracts

Abstracts 27415–28799

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

This year the Office of Scientific and Technical Information is celebrating a Forty-Year Partnership in Information Service.

The Department of Energy Office of Scientific and Technical Information (OSTI) has been a national information center since 1948, sharing information management responsibilities in three agencies—Atomic Energy Commission (AEC), Energy Research and Development Administration (ERDA), and Department of Energy (DOE).

Toward the end of the Manhattan Project era, a small AEC division established an office to "facilitate the control and exchange of nuclear research and development information". This group would become OSTI.

In July 1948, the first issue of *Nuclear Science Abstracts (NSA)* was published, using state-of-the-art technology—IBM accounting equipment was adapted to arrange punched cards and prepare indexes.

In the late 1950s and early 1960s, new methods were explored for processing and disseminating information. In January 1967, after experiments had proved the feasibility of using computers to process data and prepare publications, OSTI's first computer group was organized. About three years later, in late 1969, DOE/RECON was tested. This online system was used until December 1986.

Over the years, OSTI's responsibilities expanded, and the volume of information increased drastically. In six months in 1948, 1,751 documents were processed for inclusion in *NSA*; in contrast, in the 1980s almost 100,000 are processed in this time period.

Today information management is fully computerized. The Energy Data Information System now contains over 3 million items, and approximately 190,000 are added annually. About 25 publications are produced and distributed regularly, and approximately 230,000 copies of documents are distributed for DOE program offices each year. In addition, OSTI oversees the production and distribution of about 480,000 microfiche annually.

As a partner in DOE's Scientific and Technical Information Program, OSTI continues to have an expanded role in information management activities—both national and international—and looks forward to the next 40 years of service.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through an energy information system maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). ITIS also serves as a gateway to other government and commercial systems and provides information merging for customized information products. To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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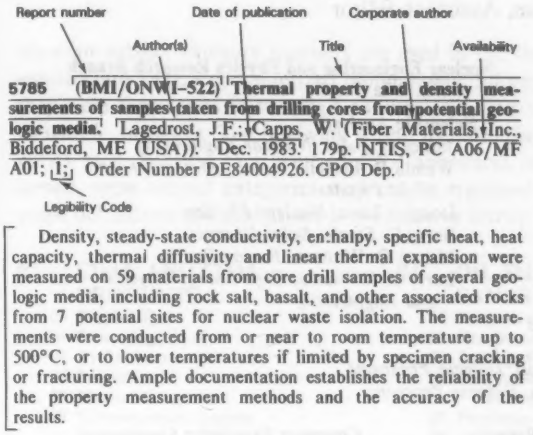
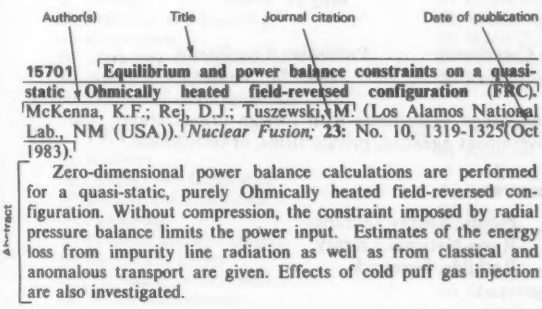
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; Order Number DE84004926. GPO Dep.
Legibility Code
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	**9:5785**	**NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70**

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CEA Centre d'Etudes de Saclay
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IEA Biomass Conversion Service
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Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

0103 Preparation

27415 **(PB—88-162953/XAB) Hydrothermal testing of San Juan Basin coal. Technical report, 17 June 1986-31 August 1987 (Final).** Lechner, T.M.; Robinson, C.W. (Public Service Co. of New Mexico, Albuquerque (USA)). Dec 1987. 167p. NTIS, PC A08/MF A01.

Considerable resources have gone into evaluating various technologies for enhancing the value of New Mexico coal deposits. The study examines one of these technologies to determine its potential for improving coal quality, reducing existing power-plant emissions, and producing new material streams that would have marketable value: the Hydrothermal Treatment Process. The project's overall objective was to evaluate the technical feasibility and economic viability of the process as it would be integrated into an existing power plant's operation.

27416 **(PB—88-859145/XAB) Coal desulfurization. January 1970-February 1988 (Citations from the Engineering Index data base). Report for January 1970-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 70p. NTIS PC N01/MF N01.

Supersedes PB—85-865350.

This bibliography contains citations concerning physical, chemical, and microbiological methods utilized in the removal of sulfur from coal. Oxydesulfurization, hydrodesulfurization, magnetic techniques, chlorinolysis, and flotation are among the processes considered. Sulfur pollution standards, environmental regulations, and process analyses and evaluations are discussed. (This updated bibliography contains 171 citations, 30 of which are new entries to the previous edition.)

0104 Processing

REFER ALSO TO CITATION(S) 27428, 27542

27417 **(PB—88-158555/XAB) Flash-pyrolysis of peat, wood, bark, and lignin. Part 2. Pyrolysis tests with Finnish peat at the University of Waterloo. Research report.** Piskorz, J.; Scott, D.S.; Westerberg, I.B.; Arpiainen, V. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). 1987. 42p. (VTT/RR—507). NTIS, PC E03/MF A01.

See also Part 1, DE—87-752481.

The publication deals with flash pyrolysis tests carried out with Finnish Peat in fluidized-bed reactors. The experimental work was performed at the University of Waterloo, Canada. A bench-scale unit (10 - 100 g/h) was the main tool in the test program. In one experiment a larger (pilot) unit (1 - 3 kg/h) was employed. Earlier pyrolysis tests with wood, bagasse, peat, straw and coal provided interesting reference data. The main objective of the work was to investigate the effects of temperature (range 450 - 750 degrees C), reactive atmosphere (nitrogen, methane), and gas-phase residence time (0.30 - 1.00 s) on the organic liquid yields. The pilot run was done at near optimal conditions to produce a larger quantity of organic liquid.

27418 **(PB—88-163415/XAB) Experimental studies of char burnoff.** Vareide, D.; Hustad, J.E.; Seonju, O.K. (SINTEF, Trondheim (Norway)). 4 Sep 1987. 26p. (STF—15-A87043). NTIS, PC E04/MF E04.

Experiments were performed in a 250-kW fluidized-bed reactor, using propane as loading fuel. The reactor is totally 5.5-m high and the inner diameter is approximately 0.3 m. Studies of char burnoff is made in the freeboard region at various height locations. The char particles are fed into the reactor just above the bed section. The 4-m high-freeboard section allow-particle residence time up to 4 s. The partially burned char particles are collected in a watercooled sampling probe, after first haveing been initially cooled with inert-gas injection at the probe inlet. The char-particle sizes varies from 90 to 268 micrometers, and the temperature range in the freeboard section was from 820 to 940 C. The oxygen concentration varies from 8% to 13.5%.

27419 **(PB—88-163803/XAB) Engineering-support services for the DOE/GRI (Department of Energy/Gas Research Institute) coal-gasification research program. Topical report: evaluation of the CNG acid gas-removal process. Volume 1. Report for January-May 1986.** Fu, R.K.; Zahnstecher, L.W. (Foster Wheeler USA Corp., Livingston, NJ). Dec 1986. 145p. (FW—21-3035-T2). NTIS, PC A07/MF A01.

Previously announced as PB—87-158895. See also Volume 2, PB—88-163811 and Volume 3, PB—88-163829.

As part of the technical support services for the DOE/GRI Joint Coal Gasification Research Program, Foster Wheeler conducted an evaluation of the low-temperature acid-gas removal process under development by CNG Research Company. Conceptual designs and cost estimates were developed for commercial-scale acid-gas removal process units based on the CNG technology. Volume 1 of the report summarizes the case study in which the CNG process is applied to treating a raw syngas stream derived from Lurgi fixed-bed gasification of lignite. Two other case studies of the CNG process considered treatment of raw syngas from ash-algommerating fluidized-bed gasification of Wyodak subbituminous coal before conventional methanation and treatment of raw syngas from ash-aglommerating fluidized-bed gasification of Wyodak subbituminous coal after Direct Methanation.

27420 **(PB—88-163811/XAB) Engineering support services for the DOE/GRI (Department of Energy/Gas Research Institute) coal-gasification research program. Topical report: evaluation of the CNG acid gas removal process. Volume 2. Report for January-May 1986.** Fu, R.K.; Zahnstecher, L.W. (Foster Wheeler USA Corp., Livingston, NJ). Dec 1986. 144p. (FW—21-3035-T3). NTIS, PC A07/MF A01.

Previously announced as PB—87-158903. See also Volume 1, PB—88-163803 and Volue 3, PB—88-163829.

As part of the technical support services for the DOE/GRI Joint Coal Gasification Research Program, Foster Wheeler conducted an evaluation of the low-temperature acid-gas removal process under development by CNG Research Company. Volume 2 of the report summarizes the case study in which the CNG process is applied to treating a raw syngas stream derived from ash-agglomerating fluidized-bed gasification of Wyodak subbituminous coal. Two other case studies of the CNG process, considered treatment of raw syngas from Lurgi fixed-bed gasification of lignite after Direct Methanation and raw syngas from ash-agglomerating fluidized-bed gasification of Wyodak subbituminous coal after Direct Methanation.

27421 **(PB—88-163829/XAB) Engineering support services for the DOE/GRI (Department of Energy/Gas Research Institute) coal-gasification research program. Topical report: evaluation of the CNG acid-gas removal process. Volume 3. Report for August-September 1986.** Fu, R.K.; Newman, S.A. (Foster Wheeler USA Corp., Livingston, NJ). Dec 1986. 105p. (FW—21-3035-T4). NTIS, PC A06/MF A01.

Previously announced as PB—87-158911. See also Volume 2, PB—88-163811.

As part of the technical support services for the DOE/GRI Joint Coal Gasification Research Program, Foster Wheeler conducted an evaluation of the low-temperature acid-gas removal process under development by CNG Research Company. Volume 3 of the report summarizes the case study in which the CNG process is applied to treating a raw syngas stream derived from ash-agglomerating fluidized-bed gasification of Wyodak subbituminous coal after Direct Methanation. Previous case studies of the CNG process, considered treatment of the raw syngas from Lurgi fixed-bed gasification of lignite after Direct Methanation and raw syngas from ash agglomerating fluidized-bed gasification of Wyodak subbituminous coal before conventional methanation.

27422 **(PB—88-173018/XAB) Testing of novel catalytic coal-gasification concepts. Task 2. Gas-phase catalysis. Subtask 2.1. Screening and selection of potential catalysts. Topical report, September 1986-March 1987.** Hill, A.H.; Anderson, G.L.; Feldkirchner, H.L.; Punwani, D.V.; Seglin, L.G. (Institute of Gas Technology, Chicago, IL (USA)). Jun 1987. 49p. NTIS, PC A03/MF A01.

Subtask 2.1 of the program to test novel catalytic coal-gasification concepts involved testing of potential gaseous catalysts for the steam gasification of coal at temperatures as low as 1000°F. Of 55 candidate halide salts and metal oxides screened, only HCl, HBr, and As_2O_4 satisfied the established selection criteria. These compounds have boiling points below 1000°F, should remain in the gas phase at gasification temperatures, could be stabilized against hydrolysis by steam, and are not expected to interact with the coal mineral matter or gasifier refractory. Although highly toxic, all three compounds are routinely recovered and produced on a large-scale commercial basis. HCl and HBr may also act as dealkylation catalysts under coal-gasification conditions and possibly increase the rate of gasification.

27423 **(PB—88-181292/XAB) Electron-transfer mechanisms in thermochemical gasification: a quantitative quantum-mechanical investigation. Annual report, January-December 1987.** Ratner, M.A. (Northwestern Univ., Evanston, IL (USA). Dept. of Chemistry). Feb 1988. 16p. NTIS, PC A03/MF A01.

See also Annual rept. for January-December 1986, PB—87-218160.

In the second year of a planned three-year project, calculations were completed on electron transfer rates between two aromatic molecules, both in the presence and in the absence of bridge assistance. The overall gasification process involves several electron transfer steps, and the rate and efficiency of these electron-transfer steps will critically influence the overall efficiency of macromolecular fragmentation and coal gasification. The calculations have clearly shown strong dependence on the nature and presence of solvent, on the orientation of the donor and acceptor groups, on the presence of hetero-atoms within the aromatic hydrocarbon structure, and on the importance of relative energy levels. Interpreting the results in terms of frontier molecular-orbital theories is quite effective. This dynamical, quantitative approach to electron-transfer rates should permit detailed understanding of the mechanism and the efficiency of the electron-transfer processes involved in non-catalyzed coal gasification.

27424 **CO hydrogenation on Ru/Al_2O_3: selectivity under transient conditions.** Zhou, X.; Gulari, E. (Univ. of Michigan, Ann Arbor). *Journal of Catalysis;* **105**: No. 2, 499-510(Jun 1987).

Transient response and isotopic tracer techniques were used to investigate the surface coverages of the reactants and the selectivity of ruthenium/alumina catalysts in CO hydrogenation. Two forms of carbon - active carbidic carbon, αC/, and hydrogen-containing alkylic carbon, βC - are found to be present on the catalyst surface. Approximately 0.1 monolayer of αC/ is deposited on the catalyst through the dissociative chemisorption of CO. βC is formed only in the presence of hydrogen. Unlike αC/, the amount of βC on the catalyst surface is found to increase continuously. Under varying partial pressures of CO and H_2 the surface coverage of αC/ changes much less than the overall rate of reaction. In addition to αC/ and βC, the catalyst surface also contained approximately 0.7 monolayer of CO and 0.1 to 0.2 monolayer of inactive carbon. Measurements of product distributions of αC/ and βC during the hydrogen titration transients show that for αC the Schultz-Flory distribution is obeyed. In contrast, βC products do not follow the same distribution. The relative selectivities of the two species of carbon during hydrogen titration transients were very different. βC titration produced normal and branched alkanes in comparable amounts. No alkene is produced from βC. αC/ titration produced primarily normal alkenes and alkanes. The results also show that the chain propagation step is much faster than the other steps in hydrocarbon synthesis (Fischer-Tropsch synthesis) and that CO dissociation is not the rate-limiting step. 21 references.

0106 Properties

REFER ALSO TO CITATION(S) 27423

27425 **(PB—88-178645/XAB) Towards a methodology for breaking carbon-carbon bonds in coal macromolecules. Final report, January 1, 1985-December 31, 1987.** Arnett, E.M. (Duke Univ., Durham, NC (USA). Dept. of Chemistry). Jan 1988. 50p. NTIS, PC A03/MF A01.

See also Topical rept. for July 1986-July 1987, PB—88-101829.

Heats of heterolysis were determined at 25 C for C-C, C-O, C-N and C-S bonds to form a variety of resonance-stabilized carbocations, carbanions, oxyanions, nitranions, and thiophenolate anions. The product ions were chosen to be reasonable models for those that would result from low-temperature heterolysis of coal macromolecular units. There are few if any prior reports of bond heterolysis energies in solution and the study of nearly two hundred calorimetric values can serve as a guide for the rational development of heterolysis processes. Furthermore, an approach using several master equations provides the means for estimating heterolysis energies from readily available values for the stabilities of the product ions. The relationship between heterolysis energies and the more-familiar homolysis energies is determined primarily by the redox potentials of the ions. An all-organic battery was developed which generates a current from the contact of carbocation and carbanion solutions in an electrolytic cell. This provides further significant evidence for electron-transfer interactions between these types of ions in solution.

27426 **Macromolecular structure of coals. Pt. 3. Equilibrium swelling of coal particles in various solvents.** Peppas, N.A.;Lucht, L.M. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering;Lawrence Livermore National Lab., CA (USA)). *Erdoel und Kohle, Erdgas, Petrochemie;* **40**: No. 11, 483-485(Nov 1987). Contract FG22-78ET13379.

Equilibrium swelling studies at 35/sup 0/C and 60/sup 0/C in various solvents, including alcohols and ketones, were performed for a wide range of coal samples. Correlations were estabilished between the equilibrium degree of swelling (Q) and the carbon content of the coal samples. The level of swelling was explained with respect in the solvent solubility characteristics. These results may be important in the analysis of the macromolecular structure of bituminous coal.

0108 Waste Management

27427 **(PB—88-178587/XAB) Influence of coal mineral matter on the effectiveness of dry-sorbent injection for SO_2 control.** Slaughter, D.M.; Thomson, W.J.; Peterson, T.W.; Chen, S.L.; Seeker, W.R. (Energy and Environmental Research Corp., Irvine, CA (USA)). Aug 1987. 272p. NTIS, PC A12/MF A01.

This report describes the use of laboratory-, bench-, and pilot-scale facilities to examine the impact of mineral matter on calcium-based sorbent reactivity toward SO_2. Two areas of concern were investigated: (1) deleterious effects of coal ash; and, (2) beneficial (promoter) effects of additive and ash minerals. The mechanisms of sorbent/mineral interactions were also studied using a variety of sophisticated techniques, including scanning electron microscopy, energy dispersive spectroscopy, x-ray spectroscopy, x-ray mi-

croprobing, and dynamic x-ray diffractometry. Coal-ash deactivation was shown to occur through the formation of calcium silicates which reduces calcium availability and promotes sintering of the sorbent. However, this mechanism was found important only when the ash and sorbent were intimately contacted prior to firing. Alkali metals and chromium-series transition elements were found to promote sorbent reactivity. The basic mechanisms involved the increase of mass transfer within sorbent particles by altering the pore structure, as well as increased solid product layer diffusion (increased ion mobility). The alkali metals were also found to react directly with SO_2.

27428 (PB—88-178595/XAB) Solid-waste codisposal screening study. Topical report, January 1985-March 1986. Stevenson, R.J.; Hassett, D.J.; McCarthy, G.J.; Manz, O.E. (North Dakota Univ., Grand Forks (USA). North Dakota Mining and Mineral Resources Research Inst.). Oct 1986. 197p. NTIS, PC A09/MF A01.

Gasification of lignite, as that underway at Beulah, North Dakota, results in solid and liquid wastes, some of which may be considered to be hazardous. The majority of the solid waste is produced as gasification wastes. Two of the liquid wastes produced were studied in the codisposal screening study and are multi-effect evaporator concentrate (MEEC) and liquid-waste incinerator blowdown (LWIBD). Adjacent to the gasification plant is the Basin Electric Cooperative Antelope Valley Station coal-combustion plant. Both scrubber and bottom ash are produced from the plant and were used in the study. The technical basis for the codisposal of these waste streams is what is explored in the report.

0120 Mining

27429 (PB—88-166509/XAB) Manual for training reclamation inspectors in the fundamentals of hydrology. Curtis, W.R.; Dyer, K.L.; Williams, G.P. (Northeastern Forest Experiment Station, Berea, KY (USA)). 1988. 64p. NTIS, PC A04/MF A01.

See also PB—82-245994.

This handbook is intended to be a desk reference to help nonhydrologists achieve a basic understanding of hydrology as it relates to surface mining and reclamation. Surface coal mining and reclamation inspectors and other staff will find it useful in implementing regulatory programs. The handbook is not meant to be a comprehensive treatment of the subject. The handbook can be used in the training of surface-mining and reclamation inspectors, both Federal and State, and as a basic reference for inspectors in carrying out their assigned duties. The handbook describes clues and indicators of potential problems, suggests ways to prevent or mitigate them, and discusses various observation and sampling techniques.

27430 (PB—88-167499/XAB) Coal-interface detector investigation. Open file report, 28 September 1984-30 November 1987. Cislo, R.P. (Wyle Labs., Huntsville, AL (USA)). Nov 1987. 212p. NTIS, PC A10/MF A01.

The report presents results of an evaluation of the effectiveness of the time-domain Coal Interface Detector developed by the General Electric Co. (GE) under contract H0155120. The sensor utilizes differences in the time characteristics of shearer vibrations as sensed by an accelerometer mounted on the ranging arm to discriminate the cutting of coal and rock. Four identical time-domain sensors were supplied by the Bureau for field evaluation. Results of the extensive field tests indicate that shearer vibration data processed by GE's time-domain signal-processing algorithm cannot be used to reliably detect when the cutting drum crosses the coal-rock interface.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 27655, 27664

0140 Combustion

REFER ALSO TO CITATION(S) 27576, 27579, 27580, 27899, 27900, 27906

27431 (PB—88-146451/XAB) Effect of coal-water slurry formulation on combustion behaviour. Matthews, K.J. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). 1987. 45p. (TPRD/M—1640/R87). NTIS, PC E05/MF E05.

Coal-Water Slurry (CWS) is a possible replacement fuel for the Board's 9 GW of oil-designed plant. The degree of derating of these boilers will depend on the burnout and ash deposition characteristics of the fuel. Both of these aspects have been investigated at Marchwood Engineering Laboratories (MEL). The document reports work on the combustibility of slurry fuels; the work on ash-deposition behavior has been reported in detail elsewhere and is summarized briefly in the Report. Combustion trials, even on the smallest practicable scale of about 0.5 MW/sub t/, require significant quantities of fuel, perhaps 2t of each formulation. Consequently, it is expensive and time consuming to investigate wide variations in fuel composition.

27432 (PB—88-160247/XAB) Improved coal-flame detection for safety and control. Phase 1 final report. Kramlich, J.C.; Folsom, B.A.; Pohl, J.H.; Poncelet, E.; Seeker, W.R. (Energy and Environmental Research Corp., Irvine, CA (USA)). 15 Apr 1983. 61p. NTIS, PC A04/MF A01.

The objectives were to evaluate whether particle temperatures could be used to detect the difference between burning and nonburning coal particles in an environment like that of a pulverized coal flame, and to determine if the coal particle temperature responds to changes in oxygen concentration in a manner consistent with use as a flame stoichiometry control device. The approach was to inject coal particles into a hot bath gas whose temperature and oxygen content could be varied. Particle temperature measurements were obtained by two-color pyrometry. The results indicated that coal particle ignition is accompanied by a discontinuous jump in particle temperature of a sufficient magnitude to be used as an ignition detector. Burning particle temperatures were found to be sufficiently dependent on local oxygen and gas temperature to indicate that the proposed stoichiometry control technique is feasible.

27433 Alkali injection system with controlled CO/sub 2//O/sub 2/ ratios for combustion of coal. Berry, G.F. (to Dept. of Energy, Washington, DC). US Patent 4,718,361. 12 Jan 1988. Filed date 21 Nov 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A combustion process for an organic fuel is described comprising the steps of providing a combustion zone for burning a fuel with oxygen, introducing an organic fuel to a combustion zone, introducing a mixture of carbon dioxide and oxygen to the combustion zone to form a combustion gas, the mixture having essentially no nitrogen gas, providing heat exchanger means downstream from the combustion zone, introducing a carbon dioxide as a cooling gas into the combustion gas between the combustion zone and the heat exchanger means to reduce the temperature of the combustion gas to below about 1150K and from a cooled combustion gas, and, recycling a portion of the cooled combustion gas to be combined with oxygen for the combustion zone.

0160 Health And Safety

REFER ALSO TO CITATION(S) 28155, 28159

02 PETROLEUM

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 27457, 28207, 28208, 28235, 28238

27434 **(PB—88-168810/XAB) Chukchi Sea oil and gas lease Sale 109, Alaska Outer Continental Shelf, Final Environmental Impact Statement. Volume 2. Final report.** Yoesting, L. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Nov 1987. 404p. (MMS/AK/EIS—87/004). NTIS, PC A18/MF A01.

This EIS (Final Environmental Impact Statement) analyzes a proposed oil and gas lease sale in the Chukchi Sea, alternatives to the proposal, major issues determined through the scoping process, and potential mitigating measures. The proposal consists of 45,450 blocks located in the Chukchi Sea Planning Area in waters that are from about 5 to 385 kilometers offshore. The conditional mean economically recoverable oil resources in the area are estimated to be 2.68 billion barrels with a marginal probability of 0.20 for hydrocarbons.

0203 Drilling And Production

27435 **(FRNC-TH—3140) Contribution to the study of shale stability while drilling.** Azzouz, S.R. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)). Nov 1983. 127p. (In French). NTIS (US Sales Only), PC A07/MF A01;1. Order Number DE88752592/JAW.

Shale drilling requires the development of drilling muds preventing shale hydration. Laboratory tests on excavation parameters such as capillary adsorption, swelling and swelling pressure show that some protective agents can limit hydratation and rock desintegration. Inhibiting power of these products is determined by an apparatus designed to study the dynamic action of a fluid on a core. Erosion kinetics of a sample placed in a fluid flow is followed by a photoelectric cell. This test shows that potassium carbonate and polyacrylamide are particularly adapted for shale stabilization.

27436 **(IFP—34-369) Study in reservoir conditions of diffusion and dispersion during miscible gas injection for enhanced oil recovery.** Hadiatno, D. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). Jun 1986. 167p. (EN, FR). NTIS (US Sales Only), PC A08/MF A01;1. Order Number DE88752588/JAW.

The experimental study on diffusion, in reservoir conditions was carried out both without a porous medium and with a porous medium. The approach was progressive;first binary mixtures (C/sub 1/ -C/sub 10/) to check our methods, then ternary mixtures (C/sub 1/ C/sub 4/ C}sub 10}) were used. The experimental principle, procedures and interpretation method are given. Dispersion was studied by displacements experiments, the oil phase (C/sub 1/ C/sub 4/ C/sub 10/) being either continuous or dispersed. The effect of the gas injection velocity and the orientation of the porous medium on oil recovery has been established. Experiments showed that the role of dispersion in the production of extra oil is greater in tertiary conditions than secondary conditions. The dispersion coefficient can only be calculated from time and money consuming experiments. Dispersion experiments were simulated numerically, using a linear, compositional mathematical model. The aim is to correlate the dispersion coefficient and practical data, such as the KOVAL number.

27437 **(IFP—34-941) Basic research on interfacial viscosities and two-phase flows.** Pouchan-Gaudin, M.P. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). 7 Nov 1986. 125p. (In French). NTIS (US Sales Only), PC A06/MF A01;1. Order Number DE88752591/JAW.

The study of two immiscible fluid flow in porous medium requires the knowledge of rheologic properties of the system. Effect of interfacial shear viscosity and interfacial dilatation viscosity is observed experimentally on tertiary recovery in porous medium, oil displacement by foams or surfactants, emulsion coalescence and stability. Influence of interfacial viscosities on two immiscible fluid flow in a porous medium is evaluated. Interfacial shear viscosity is determined by a viscosimeter and it is shown that interfacial viscosity of studied solutions increases with time (explained by a progressive organization of the structure) and that the behavior is non-newtonian. In a capillary two immiscible fluid flow is described by the Washburn equation. For any capillary radius (50, 100 or 200 micrometers) high interfacial viscosity produces an increased resistance of displacement. Fluid flow is modified especially for low speed.

27438 **A random-scission model for chemical degradation of polymer solutions.** Khorrami, P.; Radke, C.J. (Univ. of California (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 3: No. 1, 349-352(Feb 1988).

A rigorous but simple deterministic model is presented to quantify chemical degradation of high-molecular-weight polymer solutions undergoing random bond scission. Molecular-weight alteration is characterized by a fundamental rate constant, κ, whose inverse represents the average lifetime of a polymer chain bond. Evaluation of the proposed random-scission model (RSM) against known Monte Carlo (MC) calculations shows complete agreement. Given the molecular-weight decline from the RSM, the authors establish the corresponding polymer solution viscosity loss using the semiempirical Martin equation along with the Mark-Houwink relationship for intrinsic viscosity. Comparison of the RSM viscosity predictions against the chemical degradation data of Shupe for partially hydrolyzed polyacrylamide gives good agreement. Thus, a new tool is available to predict polymer chemical degradation and viscosity loss at reservoir time scales and conditions.

27439 **A multiple-porosity method for simulation of naturally fractured petroleum reservoirs.** Wu, Y.S.; Pruess, K. (Lawrence Berkeley Lab. (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 3: No. 1, 327-336(Feb 1988). Contract AC03-76SF00098.

This paper describes the application of the method of "Multiple Interacting Continua" (MINC) to the simulation of oil recovery in naturally fractured reservoirs. A generalization of the double-porosity technique, the MINC method permits a fully transient description of interporosity flow by numerical methods. The authors present examples to demonstrate the utility of the MINC method for modeling oil-recovery mechanisms by water imbibition and field applications for five-spot waterflooding and water coning problems in fractured reservoirs. All results show that the MINC method provides accurate predictions of the behavior of naturally fractured reservoirs, while requiring only a modest increase in computation work compared with the double-porosity method. The double-porosity method may result in large errors for matrix blocks of low permeability or large size.

27440 **Flow visualization of the effects of interfacial tension on displacement.** Hornof, V.; Morrow, N.R. (Chemical Engineering at the Univ. of Ottawa (CA)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 3: No. 1, 251-256(Feb 1988).

The effects of interfacial tension (IFT) on displacement behavior have been investigated through flow visualization experiments in porous media formed by thin layers of sintered glass beads. Fluid densities and viscosities were matched to avoid viscous and gravitational instabilities. Displacements were carried out with aqueous/oleic liquid pairs, which gave IFT's of 17.0, 1.2, 0.029, and 0.002 dynes/cm [17.0, 1.2, 0.029, and 0.002 mN/m]. Results show how IFT, wettability, and model heterogeneity interact to determine the shape and stability of the displacement front.

27441 **Solubility and extraction in multiple-contact miscible displacements: Comparison of N/sub 2/ and CO/sub 2/ flow visualization experiments.** Bahralolom, I.M.; Orr, F.M. Jr. (New Mexico Petroleum Recovery Research Center (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 3: No. 1, 213-219(Feb 1988).

Results of secondary and tertiary displacements of Maljamar crude oil by N/sub 2/ and CO/sub 2/ are compared to examine the effects of solubility and extraction on local displacement efficiency. The flow visualization experiments were performed in pore networks etched in glass plates. In those experiments, the much higher solubility of CO/sub 2/ in the oil caused only marginal improvement in displacement efficiency over that observed for N/sub 2/, which was much less soluble. At pressures high enough for CO/sub 2/ to extract hydrocarbons efficiently, however, displacements were much more efficient. Secondary and tertiary displacements in a more heterogeneous glass model are also compared. In a secondary displacement with high solubility but low extraction, adverse capillary and viscous effects limited the area swept to preferential flow paths. High CO/sub 2/ solubility did not appear to have significant effects. When water was present in tertiary displacements with efficient extraction and high solubility, combined effects of viscous instability, capillary forces, and heterogeneity sharply reduced sweep efficiency below that observed in secondary displacements in the same model.

27442 **Dispersion and reservoir heterogeneity.** Arya, A.; Hewett, T.A.; Larson, R.G.; Lake, L.W. (Intera Technologies Inc. in Austin, TX (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 3: No. 1, 140-148(Feb 1988).

Macroscopic dispersion is the mixing, on the scale of several hundreds of grain diameters, at a point in a permeable medium that is free of boundary effects. Megascopic dispersion is the one-dimensional (1D) dispersion derived by averaging across an entire cross section. This work investigates how both dispersions vary with heterogeneity, aspect ratio, diffusion coefficient, and autocorrelation. The theoretical results are compared to existing field and laboratory data and to existing theories for limiting cases. The degree of autocorrelation in the medium determines whether or not megascopic dispersivity (dispersion coefficient divided by velocity) is uniquely defined. Large correlation distances (with respect to the medium dimensions) imply a dispersivity that grows with distance traveled. Small correlation distances imply a dispersivity that is eventually stabilized at some constant value. This value is related to the heterogeneity of the medium. On the field scale, diffusion is insignificant, but on a laboratory scale, it can stabilize the dispersivity even if the medium is correlated. Macroscopic dispersivity is sensitive to diffusion in both the laboratory and field scale. It is smaller than or equal to megascopic dispersivity, also in conformance with experimental data, and comparable to laboratory-measured dispersivity.

27443 **Diffusion of CO/sub 2/ at reservoir conditions: Models and measurements.** Grogen, A.T.; Pinczewski, V.W.; Ruskauff, G.J.; Orr, F.M. Jr. (Ampol Exploration Ltd. in North Sidney (AU)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 3: No. 1, 93-102(Feb 1988).

Mathematical models are developed to describe the transport of dissolved CO/sub 2/ in a liquid phase, and results of measurements of the diffusivity of CO/sub 2/ in hydrocarbons and water at reservoir conditions are reported. The measurements were made with novel techniques based on the direct observation of the motion of an interface caused by the diffusion of CO/sub 2/ through oil or oil shielded by water. Diffusion coefficients were determined by fitting the mathematical models to the observed motion of the interfaces. This method allows the measurement of diffusion coefficients without the need to determine phase compositions and is therefore suited to measurements at elevated pressures (reservoir conditions). Measured diffusion coefficients are reported for CO/sub 2/ in pentane, decane, and hexadecane at 25°C [77°F] and pressures up to 6000 kPa [870 psia]). Limited measurements of CO/sub 2/ diffusion in Maljamar crude oil are also described. In addition, results of measurements for the diffusion of CO/sub 2/ in water are presented. These are the first such measurements at high pressures (up to 6000 kPa [870 pisia]). Correlations of diffusion coefficients in liquids at atmospheric pressure are shown to give reasonable estimates of diffusion coefficients for CO/sub 2/ in fluids at reservoir conditions. Finally, the measured diffusion coefficients and mathematical models are used to assess the impact of diffusive mixing on CO/sub 2/ floods at various length scales to examine the relationship between laboratory-scale corefloods and field-scale displacements.

0204 Processing

REFER ALSO TO CITATION(S) 27980, 27981

0205 Products And By-products

27444 **(AD-A—187873/5/XAB) Stability, compatibility, and related problems of additives in naval distillate fuels derived from lower-quality feedstocks. Topical report No. 2, August 1984-September 1986.** Brinkman, D.W.; Stirling, K.Q. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jan 1987. 68p. (NIPER—22). NTIS, PC A04/MF A01.

This report describes the first two years of a study co-sponsored by DOE and the U.S. Navy to determine which antioxidant additives are most effective in delaying fuel degradation in a variety of middle-distillate straight-run light-cycle oil blends. In this study, straight-run middle distillate and catalytically cracked product were mixed at ratios of 85:15, 70:30, and 60:40, respectively. All of these blended fuels were immediately treated with commercially available additives. Usual dosages were 12 and 24 ppm (volume/volume). Stability testing and fuel characterizations performed at four different laboratories were used to evaluate the additives. Each laboratory used a different type of stability test. The characterization studies were performed to ensure that the base fuel blends tested were within the range allowed by MIL-F-16884H and to determine whether any of the additives would make the fuels unacceptable for Navy use.

27445 **(AD-A—188068/1/XAB) Evaluation of bituminous materials used in pavement-recycling projects at Tyndall, Macdill, and Hurlburt Air Force Bases. Final report, February 1985-December 1986.** Kiggundu, B.; Martinez, R.; Humphrey, B.; Shuler, T. (New Mexico Engineering Research Inst., Albuquerque (USA)). Jul 1987. 212p. (NMERI-WA—5-11(5.07)). NTIS, PC A10/MF A01.

This report presents results of a study involving bituminous materials from Tyndall and MacDill Air Force Bases and Hurlburt Field. These materials included Reclaimed Asphalt Pavement (RAP), modifiers, virgin asphalts, and new aggregates. A tentative modifier-selection criterion was used to judge the quality of materials used in the recycling efforts at the respective sites. The results showed that independent adequacy of physical properties from chemical properties in selection of modifiers could not be established. However, some of the results showed that physical were more-sensitive indicators of changes in binders due to aging. In addition, this report includes the tentative modifier selection criteria and results of an interlaboratory study from which variability limits to parameters determined using modified Clay-Gel and Heithaus procedures are established. The modified Clay-Gel and Heithaus procedures are included.

27446 **(AD-A—188331/3/XAB) Asphalt-aggregate interactions in hot recycling. Final report, April 1985-March 1987.** Kiggundu, B.M.; Newman, J.K. (New Mexico Engineering Research Inst., Albuquerque (USA)). Jul 1987. 114p. (NMERI-WA—5-12-(5.10)). NTIS, PC A06/MF A01.

This report summarizes results of an investigation of asphalt-aggregate interactions in hot recycled systems. Materials used in the research included a severe stripping aggregate and a nonstripping aggregate. Both were evaluated using the Lottman 70% retained tensile-strength criteria. Additional materials included a 40/60 RAP new aggregate system, one virgin asphalt, two RAP recovered binders, one modifier or recycling agent, and two blends. The modifier was selected using a recently developed specification involving physical, composition, and solubility properties. Aggre-

gates were evaluated for surface area, bulk composition, water-soluble ions, cation exchange capacity, gradation, and specific gravities. Binders were tested for physical properties and composition properties using a modified Clay-Gel procedure, and compatibility properties using a modified Heithaus procedure.

27447 **(AD-A—188361/0/XAB) Analysis of model fuels and their compatibility with selected elastomers. Part 1. Interim report, March-September 1987.** Fodor, G.E.; Bailey, B.K.; Present, D.L.; Kohl, K.B. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Sep 1987. 68p. (BFLRF—238). NTIS, PC A04/MF A01.

In this program, three diesel fuels and a diesel-fuel-blending component are analyzed in initiative development of a diesel-fuel compositional data base to be used to (a) design a repeatable-quality, model-compound based diesel-fuel simulant for the evaluation of fuel-elastomer compatibility, and (b) aid in understanding and ultimately controlling fuel-elastomer interactions. The initial results of compatibility studies between fresh and thermally aged diesel fuels, and four elastomer-based fuel tank materials are summarized in this report.

27448 **(AD-A—188447/7/XAB) High-shear-rate rheometry of low-viscosity liquids. Final report, 1 April 1984-30 September 1987.** Lodge, A.S. (Wisconsin Univ., Madison (USA). Dept. of Engineering Mechanics). 24 Nov 1987. 4p. NTIS, PC A02/MF A01.

A new instrument called LODGE STRESSMETER was developed to measure the shear elasticity and viscosity of general and multigrade oils at high shear rates. This will make possible the measurements of normal stress difference N1 for values of shear rate up to 5×10^5 at temperature of 150 C. New surprising data show (as yet unexplained) the N1 contribution to the minimum oil-film thickness could be as much as 75% of the contribution from viscosity. This raises hope for the use of oils with lower viscosity, leading to improved fuel economy and an increase in the range of motorized vehicles.

27449 **(AD-A—188497/2/XAB) Flammability characteristics of distillate fuels. Interim report, February 1985-June 1987.** Kanakia, M.D.; Wright, B.R. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Jul 1987. 55p. (BFLRF—234). NTIS, PC A04/MF A01.

The objectives of this effort were to develop basic information on flammability characteristics of diesel and turbine engine fuels and to provide useful criteria for prediction of fuel-fire dynamics in a hostile environment due to armor/fuel cell penetration. Four selected representative fuels (DF-1, DF-2, JP-8, and high-aromatic-content light-cycle oil) were extensively characterized for important physiochemical properties. The fuels were chemically analyzed by gas chromatography (GC)/mass spectrometry (MS), and proton and carbon-13 nuclear magnetic resonance. Thermophysical properties of the fuels were determined by differential scanning calorimetry and steady-state hot-wire thermal-conductivity cells.

27450 **(AD-A—188874/2/XAB) Comparison of JFTOT heater-tube-deposit rating methods for the evaluation of fuel thermal stability. Interim report.** Morris, R.E.; Hazeltt, R.N.; McIlvaine, C.L. (Naval Research Lab., Washington, DC (USA)). 29 Dec 1987. 17p. (NRL-MR—6147). NTIS, PC A03/MF A01.

Quantification of deposits formed on heated metal surfaces is desirable for the evaluation of thermal stability by the JFTOT procedure. Empirical methods widely employed entail either visual comparisons or measurements of reflected light (TDR), both of which are sensitive to deposit color. The authors examined these and several other measurement techniques for JFTOT heater tubes and found that measurements of total carbon content by combustion were the most reliable. Two novel techniques, based on measurements of dielectric strength and interference effects of monochromatic light have been examined. It was found that the dielectric and interference methods correlated well with the combustion analyses and each other, while the TDR often yielded misleading results. The correlations between the various methods will be discussed in addition to the consequence of method choice on the interpretation of experimental data.

27451 **(AD-A—955313/2/XAB) Sectionalized-plywood, petroleum barges.** Clement, C.H. (Engineer Board, Fort Belvoir, VA (USA)). 15 Jul 1943. 72p. NTIS, PC A04/MF A01.

This report covers the tests of a plywood barge for the transportation of petroleum products or deck loads. It recommends one of the designs tested as satisfactory for this purpose. It finds three types of cell linings that will prevent the leakage of gasoline. It further finds that a section of the barge may be used for fuel storage.

27452 **(PB—88-155098/XAB) Potential for diesel and fuel-oil replacement.** (New Zealand Energy Research and Development Committee, Auckland). Sep 1987. 170p. (NZERDC—151). NTIS, PC E07/MF A01.

As part of the transport-fuel self-sufficiency program, this study aimed to provide detailed information on diesel use in New Zealand in order to assess alternatives to diesel. In large measure, the higher derivatives of petroleum will be readily replaced by natural gas and related products.

27453 **(PB—88-168919/XAB) Diesel-fuel quality and its relationship with emissions from diesel engines.** (Concawe, The Hague (Netherlands)). 1987. 28p. (CONCAWE—10/87). NTIS, PC E03/MF A01.

CONCAWE predicts future (year 2000) diesel-fuel properties to be essentially in the range of 43 to 54 cetane number (median value: 48.5) and 0.825 to 0.870 density (median value: 0.846). Compared with present average commercial European diesel fuels, this means a drop in cetane number by 2 and an increase in density by 0.006; however, the spread in quality remains similar. Operating costs for the EEC oil industry to compensate for these changes would amount to some $38 to $45 million per year if ignition improvers were employed and $1.3 to $1.7 billion/year if hydrogenation processes were installed. Updating the diesel engine homologation fuel specification to reflect changes in commercial fuel properties would reliably ensure that certified emissions standards will be met in the field, despite variations in fuel quality. In addition, advances in engine technology, which are already emerging in the USA, represent viable measures for improving the emissions performance of diesel engines.

27454 **(PB—88-859244/XAB) Marine fuels. January 1973-February 1988 (Citations from Information Services in Mechanical Engineering data base). Report for January 1973-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 99p. NTIS PC N01/MF N01.

Supersedes PB—87-851515.

This bibliography contains citations concerning research and experimentation, fuel-system design, future demands, contrast and comparisons, and applications of various marine-engine fuels and lubricants. Residual fuel oils, coal-powered steam propulsion, homogenizing and treating fuels, coal liquefication, diesel-fuel power, electrical power, gas turbines, waste-exhaust heat-energy recovery systems, exhaust emissions, water-emulsified fuels, conservation, and nuclear fuels are among the topics discussed. Developments in fuels and their effects on power-plant wear are included. (This updated bibliography contains 260 citations, 73 of which are new entries to the previous edition.)

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 27460

27455 **(AD-A—188065/7/XAB) Degradation of jet and missile fuels by aquatic microbial communities. Final report, October 1982-October 1984.** Pritchard, P.H.; Mueller, L.H.; Spain, J.C.; Bourguin, A.W. (Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab.). Jul 1987. 175p. NTIS, PC A08/MF A01.

The fate of jet fuel (JP-4) in aquatic sediments was studied concomitantly in laboratory test systems and in the field. Sediments from an estuarine pond were dosed with jet fuel and then reapplied to the pond as well as into plexiglass trays on the sediment bed and quiescent bottle tests in the laboratory. Thirty-three selected hydrocarbons in the jet fuel were followed chemically to quantitate relative hydrocarbon losses. Several hydrocarbons which biodegraded or rapidly volatilized in the bottle tests, were much slower to disappear in the field and the plexiglass trays. In general, mixing of the jet fuel with sediments increased the persistence of the associated hydrocarbons. The fate of missile fuels in aquatic systems was also investigated. The high density missile fuels RJ-5 and JP-9 resisted biodegradation when incubated with water/sediment suspensions collected from aquatic habitats. RJ-5 and JP-9 were not toxic to the microbial communities at concentrations of 400 mg per liter, but RJ-5 was toxic to Mysidopsis bahia in 96-hour acute tests (LC50 88 micrograms/liter).

27456 **(PB—88-159009/XAB) Measurement of vertical turbulent dispersion and diffusion of oil droplets and oiled particles. Final report, September 1985-December 1987.** Delvigne, G.A.L.; van der Stel, J.A.; Sweeney, C.E. (Engineering Hydraulics, Inc., Redmond, WA (USA)). Dec 1987. 499p. NTIS, PC A21/MF A01.

Also pub. as Waterloopkundig Lab. te Delft (Netherlands) rept. No. Z-75-2.

This study is intended to develop mathematical relations for the turbulent dispersion of spilled oil and oiled particles in the sea. The laboratory experiments were conducted to provide a basis for the mathematical relations with empirical data on oil dispersion and oil-SPM interaction. Empirical relations and data were obtained for the following processes: (a) break-up of surface oil films into droplets, and intrusion of droplets in the water column, due to breaking-wave effects; (b) break-up of submerged oil parcels (submerged leak) into droplets due to turbulence in the seawater; (c) interaction between oil droplets and SPM. The empirical relations can be used in mathematical models with given hydrodynamic conditions and breaking-wave statistics.

27457 **(PB—88-166939/XAB) Oil-spill risk analysis: central, western, and eastern Gulf of Mexico (proposed sales 113, 115, and 116) Outer Continental shelf. Final report.** Hannon, L.J.; LaBelle, R.P.; Lucas, A.D. (Minerals Management Service, Reston, VA (USA)). Oct 1987. 132p. (OCS/MMS—87/0117). NTIS, PC A07/MF A01.

The Minerals Management Service recently released the Oil-Spill Risk Analysis Report for Proposed Gulf of Mexico OCS Oil and Gas Lease Sales 113, 115, and 116 by Lawrence Hannon, Robert LaBelle, and Doreen Lucas. The 132-page report summarizes the results of the oil-spill trajectory analysis which was used to estimate potential oil-spill risks from the proposed sales. The report was prepared as part of the Environmental Impact Statement for Sales 113, 115, and 116; which are scheduled to be held in March, August, and November 1988, respectively.

27458 **(PB—88-167812/XAB) Beaufort Sea monitoring program: analysis of trace metals and hydrocarbons from Outer Continental Shelf (OCS) activities. Final report, December 1987.** Boehm, P.; Steinhauer, M.; Crecelius, E.; Neff, J.; Tuckfield, C. (Battelle Ocean Sciences, Duxbury, MA (USA)). 21 Dec 1987. 286p. NTIS, PC A13/MF A01.

See also PB—87-115945.

A 3-year study was initiated in 1984 to develop and implement a monitoring program for evaluating potential impacts of anticipated offshore oil and gas exploration and production activities on the U.S. Beaufort Sea continental shelf. The program was designed to detect and quantify temporal changes in the concentrations of metals and hydrocarbons in sediments and animal tissues, and to relate such changes to oil and gas development activities. A set of null hypotheses was designed to evaluate the environmental impacts of the Beaufort Sea OCS oil and gas-related activities. Although sediment trace metals and hydrocarbons encompass a wide range of concentrations, there is no evidence that oil and gas activities have contaminated Beaufort Sea sediments or biota. In contrast to the elevated levels of polynuclear aromatic hydrocarbons (PAH's) in the sediments, concentrations in the animal tissues were detectable but very low, indicating that, although present in the sediments, PAH's are not readily bioavailable.

27459 **(PB—88-858931/XAB) Oil spills: biological effects. June 1981-February 1988 (Citations from the NTIS data base). Report for June 1981-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 74p. NTIS PC N01/MF N01.

Supersedes PB—82-810391.

This bibliography contains citations concerning the biological and ecological effects of oil spills. The effects on microorganisms, plants, and animals are studied. Damage assessment, ecological modeling, and environmental impact statements are included. (This updated bibliography contains 152 citations, 29 of which are new entries to the previous edition.)

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 27451

27460 **(PB—88-165774/XAB) Performance of oil-industry cross-country pipelines in Western Europe: statistical summary of reported spillages - 1986.** Rudolph, E.K.; Bianchini, M.; Gilla, G.; Beuillard, C.; Brandt, J. (Concawe, The Hague (Netherlands)). 1987. 26p. (CONCAWE—8/87). NTIS, PC E03/MF A01.

See also report for 1985, PB—87-153243.

The report is the latest in a series of annual reports issued by CONCAWE reviewing the performance of oil-industry cross-country pipelines in Western Europe. It includes details of the pipeline network to which it refers, and analyses reported spillage incidents by cause and effectiveness of clean-up. Causes are categorized as: mechanical failure, operational error, corrosion, natural hazard and third party activity. The report concludes with a five-year comparison and trend analysis of reported spillages. It contains an overall map of the Western European oil-industry cross-country pipeline system and more detailed maps of the pipeline networks of the Le Havre-Paris, Golfe de Fos, Rotterdam-Europoort and Northern Italy areas.

0230 Properties

REFER ALSO TO CITATION(S) 27834, 27855

27461 **(IFP—34-960) Study of the structure of petroleum polar fractions (resins and asphaltenes) by selective chemical degradation.** Trifilieff, S. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). Mar 1987. 195p. (In French). NTIS (US Sales Only), PC A09/MF A01;1. Order Number DE88752586/JAW.

For molecular and structural characterization of petroleum heavy products, asphaltenes from four heavy oils (precipitated with n-heptane) are oxidized with ruthenium tetroxide and formation of carboxylic acids is observed. Molecular structure determination and a test simulating maturation are described. Comparative analysis of acids obtained by asphaltene oxidation and of light fraction components (hydrocarbons and acids) allows a partial determination of structures and mechanisms. Then resins oils studied are hydrogenated with Raney nickel for desulfurization, hydrocarbon compounds obtained are analysed and compared to light fraction constituents. Several hypothesis are proposed for resin structure.

0250 Combustion

REFER ALSO TO CITATION(S) 27899

03 NATURAL GAS

REFER ALSO TO CITATION(S) 27419, 27542

27462 **(PB—88-181284/XAB) Development of an efficient, low-NOx domestic gas-range cooktop. Phase 3. Annual technical report, January 1986-December 1986.** Shukla, K.C.; Hurley, J.R.; Grimanis, M.P. (TECOGEN, Inc., Waltham, MA (USA)). Jun 1987. 63p. (TE—4368-104-87). NTIS, PC A04/MF A01.

See also Annual rept. for Phase 2, January-December 1984, PB—85-246411.

The objective of the program is to develop a domestic cooktop with low-NOx emissions and high efficiency. During the first two phases of the program, three design concepts were developed, and two versions of developmental prototypes using the IR-Jet approach were fabricated and tested. The third phase was initiated to address the design issues of burner turndown and modulation and to conduct the field test of a prototype with one IR-Jet and three conventional burners. Two prototypes containing one IR-Jet and three conventional burners and utilizing blower speed control for air/gas modulation were fabricated. One unit employed a brushless dc motor and the other a 2-pole ac motor. The ac motor prototype was field tested. Field testing showed the need for a mechanical air/gas valve for modulation and for a 1500 Btu/hr simmer setting. A 4-inch-diameter stepped-tile configuration provided input rates from 1500 to 8000 Btu/hr. A manufacturer, Copreci of Spain, started the development of a low-cost air/gas valve.

0301 Reserves

27463 **(PB—88-181276/XAB) Documentation and review of Eastern gas shales technology. Final report, April 1, 1984-December 31, 1986.** Keltch, B.; Vogel, M.D.; Pruett, L.T. (BDM Corp., McLean, VA (USA)). May 1987. 101p. NTIS, PC A06/MF A01.

See also Annual rept. for April 1985-February 1986, PB—86-233814.

Technical and economic assessments of recoverable gas from the Devonian shales were performed to quantify the potential impacts that technology advancements could have on gas marginal cost-supply relationships. An area of 22,056 square miles (approximately 20% of Appalachian Basin underlain by Devonian shale) is considered in the analysis. The study area contains 123.5 TCF of in-place gas. Gas production flow models and cost models developed for the analysis indicate maximum recoverable reserves using Base Case Technology to be 22.1 TCF and 51.7 TCF using Advanced Case Technology.

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 27434, 28235, 28238

27464 **(PB—88-178678/XAB) Seismic detection of fractured Devonian-shale reservoirs. Final report, July 1, 1985-July 30, 1987.** Wilson, T.H.; Shumaker, R.C.; Sims, C. (West Virginia Univ., Morgantown (USA). Dept. of Geology). Aug 1987. 168p. NTIS, PC A08/MF A01.

See also Annual rept. for July 1985-June 1986, PB—87-134078.

Analysis of conventional 2D and 3D seismic data from Devonian-shale gas fields in West Virginia indicate that seismic data can be used to map stratigraphic variations within a shale sequence. Seismic evidence also reveals the presence of syndepositional and post-depositional structural controls in both fields. The occurrence of local stratigraphic variations and the anomalous intensely fractured areas observed in the seismic data are not confined to the highly productive areas within these fields. However, the active influence of deeper basement structures during and after the deposition of the producing shale intervals appears to be a controlling element in the development of both fields. A Kalman/Mendel deconvolution algorithm was developed that yields a better estimate of the reflectivity sequence than the conventional Weiner filter. A reduced-order solution to the estimation problem was also developed to reduce computation time. Comparative analysis of structure and isopotential maps in the Eastern Kentucky field shows that wells with high gas flows follow basement fault zones that are occasionally expressed as surface lineaments. Regional-fracture permeability occurs in organic shales that are decollement zones in the adjacent Appalachian foreland.

0303 Drilling, Production, And Processing

27465 **(PB—88-173109/XAB) Characterization of produced waters from natural-gas-production operations. Executive summary. Topical report, July 1986-December 1987.** Wesolowski, D.; Broughton, A.; Hansotte, C.A.; Karaido, S.M.; Fillo, J.P. (ERT, Pittsburgh, PA (USA)). Dec 1987. 22p. NTIS, PC A03/MF A01.

See also PB—88-173091.

This report presents the results of a nationwide characterization program for produced waters from non-associated natural-gas-production operations. The results of the program indicate that the characteristics and volumes of produced waters are highly variable, site-specific, and dependent on the characteristics of the the producing formation. In general, the produced waters sampled in the program contained volatile organics and, to a lesser degree, selected semivolatile organics. Selected minor and trace elements also were present in the produced water samples. Chloride and total dissolved solids were the most predominant conventional parameters detected. Produced waters did not generally exhibit current RCRA hazardous-waste characteristics. The predominant method used to dispose of these waters is underground injection into Class II wells regulated under the Safe Drinking Water Act.

0306 Marketing And Economics

27466 **(PB—88-161609/XAB) Gas Research Institute 1984 appraisal results report.** (Gas Research Inst., Chicago, IL (USA)). Jun 1983. 92p. (GRI—83/0084). NTIS, PC A05/MF A01.

See also PB—88-141601.

This report describes GRI's 1984 planning process using GRI's Project Appraisal Methodology (PAM). The report describes the 1984 PAM process, explains the functional roles of the GRI staff and management, documents the special treatment of several technology-specific and non-generic environmental research project areas, and presents the results of the appraisal of the 1984 Research and Development (R and D) program. The appendices contain the 1984 PAM Reference Database, the 1984 PAM Input Data Form, and a summary of 1984 PAM data. PAM is an incremental benefit/cost assessment in which quantitative and qualitative measures of performance, R and D costs, and professional judgement play integral roles. PAM provides a project area ranked list that identifies those project areas and funding levels which should provide the greatest overall benefit per R and D dollar. The PAM process concludes with a review of the ranked list and selection of the final R and D portfolio and budget based on established guidelines.

27467 **(PB—88-171798/XAB) Competitive position of natural gas: central thermal fluid systems (CTFS) for plastics curing and forming. Topical report, May 1986-October 1987.** Williams, S.; Koch, G.S. (Hagler, Bailly and Co., Washington, DC (USA)). Oct 1987. 138p. NTIS, PC A07/MF A01.

Interviews with equipment manufacturers, vendors, engineering firms, and gas utilities were conducted to identify the current curing and forming operations, economic and technical conducted to identify the current curing and forming operations, economic and technical variations between gas and electric technologies, and recommendations for areas that would improve the competitive position of gas technology in the plastics industry. Results indicate that the economics of CTFS depend on total system size (heat output required, number of units to be served) and the extent

to which the in-place process heating system can be converted or adapted to accept the gas system. Using a 2-year payback criterion, gas becomes attractive at sizes greater than 100 to 120 kW (350,000 to 400,000 Btu/hr). Comparisons based on levelized annual cost indicate gas is preferable at sizes greater than 135,000 Btu/hr, but gas systems are currently available only at sizes greater than 200,000 Btu/hr.

27468 **(PB—88-174263/XAB) Commercial buildings, energy consumption, and natural gas markets.** Brodrick, J.R. (Gas Research Inst., Chicago, IL (USA)). Jun 1986. 35p. (GRI—86/0311). NTIS, PC A03/MF A01.

This report presents an overview of natural gas use in the U.S. commercial energy markets. The gas industry is in the position of protecting its share in the heating market, competing vigorously for the water heating and cooking markets, and aggresively increasing its share in the space-cooling market. Energy consumption in commercial buildings in 1979 was 5.5 quads; gas provided 2.354 quads. Electricity is the largest competitor in all commercial markets. On a national basis, natural gas and electricity equally share the market for space heating and water heating applications, electricity has a stronger share of the cooking market, and the space-conditioning market is effectively all-electric. In terms of building type, office buildings consume 39% more electricity, retail buildings consume about equal amounts of electricity and natural gas, and warehouse buildings consume 26% more natural gas.

27469 **(PB—88-174271/XAB) Gas-supply response in a low-oil-price world: summary of the annual energy seminar for the Gas Research Institute Board of Directors and Advisory Council (7th), Napa, California, August 4-6, 1986.** Farrell, M.D. (Gas Research Inst., Chicago, IL (USA)). Dec 1986. 41p. (GRI—86/0308). NTIS, PC A03/MF A01.

The document summarizes the major points made by speakers and participants in a GRI-sponsored energy seminar on the responce of gas markets and gas supplies to reduced oil prices in 1986 and the ongoing changes in the regulation of interstate pipelines. The first session presented GRI's view of the outlook for near- and long-term gas supply. It also focused on the current supply/price of gas and oil from the perspective of a major U.S. gas producer and the U.S. regulatory climate as it effects gas supply and price. The second session focused on various views of the technology needed to increase supply availability and make gas production more economical. The discussion centered on the role of technology in minimizing risk and uncertainty in order to attract investment capital once the current environment of surplus gas deliverability and falling wellhead prices ends.

27470 **(PB—88-178637/XAB) State-of-the-art in humidity sensing. Topical report, January-October 1986.** Yudow, B.D.; Zawacki, T.S. (Institute of Gas Technology, Chicago, IL (USA)). Dec 1987. 41p. (REPT—30570-15). NTIS, PC A03/MF A01.

A state-of-the-art assessment of the science and technology of humidity sensing and measurement was carried out by means of a literature search and a survey of manufacturers. The purpose of the study was to determine suitable humidity sensors and instrumentation applicable to gas appliance and space-conditioning functions that could result in enhanced product quality, improved comfort, reduced spoilage, increased efficiency, etc.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 27458

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 28237, 28304

0340 Combustion

REFER ALSO TO CITATION(S) 27581, 27693

27471 **(PB—88-174255/XAB) Combustion systems: a porous-matrix burner and a surface combustor. Topical report, June 1984-December 1985.** Jasionowski, W.J.; Kunc, W.; Khinkis, M.J.; Zawacki, T.S. (Institute of Gas Technology, Chicago, IL (USA)). Dec 1987. 71p. NTIS, PC A04/MF A01.

In this study, two combustion systems were experimentally evaluated for potential application to gas-fired appliances: an atmospheric porous-matrix burner and a packed-bed surface combustor. The normal radiant output of a porous matrix burner was measured over a range of input from 30,000 to 110,000 Btu/h-sq ft and aerations from 0% to 40% excess air. The data were compared to similar published data for radiant tile burners. Emissions of nitric oxide (NO), nitrogen dioxide (NO_2), and carbon monoxide (CO) were also measured and reported. The potential advantage of the type of burner is its ability to produce high levels of radiation heat at high gas-loading levels (Btu/h-sq ft.).

27472 **(PB—88-178629/XAB) Electrocatalyst surfaces. Annual report, January-December 1987.** Hubbard, A.T. (Cincinnati Univ., OH (USA). Dept. of Chemistry). Jan 1988. 60p. NTIS, PC A04/MF A01.

The structure, composition, and electrochemical reactivity of Pt, Ru, Rh, Pd, Ir and Au surfaces are being investigated. Adsorbed layers formed on these surfaces in aqueous solutions are investigated as a function of electrode potential, pH, temperature, nature of the electrolyte ions, nature of the organic fuel, concentrations of solute species, electrode surface structure, and surface roughness. Unique instrumentation is employed for these experiments: LEED for surface atomic and molecular structure; Auger specroscopy for surface elemental composition; EELS and surface FTIR for adsorbate vibrational characterization; x-ray photoelectron spectroscopy for surface electronic structure; and UHV-compatible electroanalysis apparatus for electrochemical characterization. Each of these techniques is applied to each electrocatalyst without exposing the surface to air or other contaminants. Data gathered during the project are identifying fertile areas for practical development and providing a framework for future basic research in the area. These experiments are revealing a number of important aspects of electrocatalytic reactions: the most-active surface planes, imperfections, additives and impurities; the identities of adsorbed intermediates and surface-blocking adsorbates; the molecular basis for the dependence of electrocatalytic activity upon pH, potential, concentration, temperature and nature of the participating species; and the comparative electrocatalytic activities of well-defined surfaces of metals.

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 27488, 28225

27473 **(INIS-BR—1036) Studies on radioactivity distribution and radioactive mineral identification in uranium ores from Espinharas (PB), Brazil.** Oliveira, G.N.M. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1979. 122p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702300/JAW.

Studies about the identification of radioactive minerals in uranium bearing rocks from Espinharas (PB), Brazil are presented. Autoradiography with α-sensitive nuclear emulsions was utilized for determining radioctivity distributions and for localizing radioactive minerals, in combination with microscopy, X-ray diffractometry, PIXE and eletron microprobe analysis for its identification. Mineralized gneisse and feldspatic rock, the two principal samples studied, show distinct differences in radioactive distribution patterns, however the main carriers for U and Th seem to be the same. Microanalysis shows that elements are associated with Si, Ca, Fe and Al an some trace elements like Y, Zr, Ti, etc. U and Th are distributed uniformly in feldspatic rock and inhomogeneously in mineralized gneisse, indicating that the zonary structure of the radioactive cristals, frequently observed in gneisse, could be due to variable U:Th ratios. Chemical analysis, X-ray diffraction datas and microscopic studies indicates that the principal carrier for radioactivity in the rocks of Espinharas is a silicate mineral of U and Th, probably situaded in the series of transition: Coffinite -> uraninite, thorogummite -> thorianite. Some additional experiments about leachability of uranium with diluted sulfuric acid are reported, which confirm the different nature of radioactivity distribution in feldspatic and gneissic rocks.

27474 **(RISO-M—2646) Gamma-ray analysis for U, TH and K on bulk cutting samples from deep wells in the Danish subbasin and the North German basin.** Leth Nielsen, B.; Loevborg, L.; Soerensen, P.; Mose, E. (Risoe National Lab., Roskilde (Denmark)). Apr 1987. 82p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752803/JAW.

A total of 1329 bulk cutting samples from deep wells in Denmark were analysed for U, Th and K by laboratory gamma-ray analysis. Contamination of the samples by drilling mud additives, mud solids and fall out was studied by means of a wash down experiment and by comparison with the total gamma-ray response from wire-line logging. It is concluded that the inorganic geochemistry on bulk cutting samples must be applied with great caution. The data are useful for geochemical characterization of well sections and for regional geochemical correlation. Radioelement abundance logs and radioelement ratio logs are presented from 3 wells in the Danish Subbasin and 2 wells in the North German Basin. The radioelement geochemistry is discussed for the successive lithostratigraphical units and a reference radio element profile is established for the central part of the Danish Subbasin. Finally, a model describing the relationship between common lithofacies and their U content and Th/U ratio is suggested. The model deliniates the depositional environment and the relative distances to the provenance areas. It is concluded that 1) Uranium is mobile during deposition, but since then it is fixed by stable mineral phases at depth. 2) Thorium reflects source area characteristics and that any available ions are readily adsorped by clay minerals. Thorium anomalies may thus serve as lithostratigraphical markers. 3) Potassium occurs in unstable rock forming mineral phases. The present distribution is controlled not only by the clastic mineral assemblage, but also by the diagenetic processes through geologic time. 33 refs.

0504 Feed Processing

27475 **(INIS-BR—1021) Spectrophotometric determination of uranium using quercetin.** Barros, A.R. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). Oct 1972. 35p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702286/JAW.

A spectrophotometric method for quantitative determination of uranium, using a flavone (quercetin) as complexing agent, is described. The method is based on the reaction between uranyl ion and alcoholic solution of quercetin with a complex formation of intense yellow color. (M.C.L.).

27476 **Method for converting uranium oxides to uranium metal.** Duerksen, W.K. (to Dept. of Energy, Washington, DC). US Patent 4,717,420. 5 Jan 1988. Filed date 27 Jan 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for converting uranium oxide to uranium metal is described comprising the steps of heating uranium oxide in the presence of a reducing agent to a temperature sufficient to reduce the uranium oxide to uranium metal and form a heterogeneous mixture of a uranium metal product and oxide by-products, heating the mixture in a hydrogen atmosphere at a temperature sufficient to convert uranium metal in the mixture to uranium hydride, cooling the resulting uranium hydride-containing mixture to a temperature sufficient to produce a ferromagnetic transition in the uranium hydride, magnetically separating the cooled uranium hydride from the mixture, and thereafter heating the separated uranium hydride in an inert atmosphere to a temperature sufficient to convert the uranium hydride to uranium metal.

0507 Fuels Production And Properties

27477 **Nuclear reactor fuel structure containing uranium alloy wires embedded in a metallic matrix plate.** Travelli, A. (to Dept. of Energy, Washington, DC). US Patent 4,720,370. 19 Jan 1988. Filed date 25 Oct 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A nuclear fuel-containing plate structure for a nuclear reactor is described; such structure comprising a pair of malleable metallic non-fissionable matrix plates having confronting surfaces which are pressure bonded together and fully united to form a bonded surface, and elongated malleable wire-like fissionable fuel members separately confined and fully enclosed between the matrix plates along the interface to afford a high fuel density as well as structural integrity and effective retention of fission products. The plates have separate recesses formed in the confronting surfaces for closely receiving the wire-like fissionable fuel members. The wire-like fissionable fuel members are made of a maleable uranium alloy capable of being formed into elongated wire-like members and capable of withstanding pressure bonding. The wire-like fissionable fuel members are completely separated and isolated by fully united portions of the interface.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 27508, 27531, 27599, 27923, 27924, 28304

27478 **Effect of burnup level on oxidation of LWR spent fuel.** Campbell, T.K.; Gilbert, E.R.; Knox, C.A. (Pacific Northwest Lab., Richland, WA 99352 (USA)). pp 369-374 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC06-76RL01830.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Oxidation tests on bare pressurized water reactor (PWR) and boiling water reactor (BWR) spent fuel fragments under static air cover gas conditions are being conducted in the presence of a 10/sup 5/ R/h gamma field. Test temperature levels are between 135°C and 230°C. Visual examination of the 230°C BWR specimens revealed that the period of time to form low-density powder increased with increasing burnup level for burnups between 8 and 34 GWd/MTU. Cumulative weight gain data up to 5 wt%, however, was essentially independent over the same burnup range. The PWR fuel specimens did not form powder after 4000 hours of exposure; thus, powder formation appears to occur earlier on BWR fuels.

27479 **TRUPACT-I is a technically viable packaging for transporting DOE's contact-handled transuranic waste.** Harmon, L.H. (U.S. Dept. of Energy, Washington, DC 20545 (USA)). pp 287-288 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The implementation of Public Law 96-164 authorizes the Secretary of Energy to proceed with the Waste Isolation Pilot

Plant (WIPP) for "the express purpose of providing a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States exempted from regulation by the Nuclear Regulatory Commission." A development program has resulted in a tested, safe, and efficient packaging for transport of DOE's contact-handled transuranic waste.

27480 **A model of gas generation and transport within TRU waste drums.** Smith, F.G. III. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC 29808 (USA)). pp 293-298 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC09-76SR00001.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A computer model has been developed to predict radiolytic gas generation and transport within Transuranic (TRU) waste drums. Gas generation from the radiolytic decomposition of organic material contaminated with plutonium is modeled. Concentrations of gas throughout the waste drum are determined using a diffusional transport model. The model accurately reproduces experimentally measured gas concentrations. With polyethylene waste in unvented drums, the model predicts that hydrogen gas can accumulate to concentrations greater than 4 mole % (lower flammable limit) with about 5 Ci of plutonium. Polyethylene provides a worst case for combustible waste material. If the drum liner is punctured and a carbon composite filter vent is installed in the drum lid, the plutonium loading can be increased to 240 Ci without generating flammable gas mixtures.

27481 **Processing of transuranic waste at the Savannah River Plant.** Daugherty, B.A.; Salizzoni, L.M.; Mentrup, S.J. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC 29808 (USA)). pp 303-306 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC09-76SR00001.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Department of Energy (DOE) has instituted a national program to isolate defense TRU waste in a deep geological repository, the Waste Isolation Pilot Plant (WIPP), in Calsbad, New Mexico. Since 1972, the highly toxic and long half-life transuranic (TRU) waste at the Savannah River Plant (SRP) has been stored on above-grade concrete pads in 55-gallon drums, large carbon steel boxes, and concrete culverts. As part of the national program, a major project is planned at SRP to retrieve and process this waste. This project, the TRU Waste Facility (TWF), will provide equipment and processes to retrieve TRU waste from 20-year retrievable storage and prepare it for permanent disposal at the WIPP. This project is an integral part of the SRP Long Range TRU Waste Management Program to reduce the amount of TRU waste stored at SRP. The TWF is designed to process 15,000 cubic feet of retrieved waste and 6,200 cubic feet of newly generated waste each year of operation. This facility is designed to minimize direct personnel contact with the waste using state-of-the-art, remotely operated equipment. In support of the TWF, a remote size-reduction and material handling process is being cold-tested at the Savannah River Laboratory. The process consists of a large, low-speed shredder and material handling system, a remote worktable, bagless transfer system, and a robotically controller manipulator.

27482 **Spent fuel storage technology demonstrations at the Idaho National Engineering Laboratory (INEL).** Schoonen, D.H.; Jensen, M.F.; Fisher, M.W. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415 (USA)). pp 361-368 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC07-76ID01570.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Spent nuclear fuel research and development activities are conducted in accordance with Section 218 of the 1982 Nuclear Waste Policy Act (NWPA). Major objectives of Section 218 are to encourage and expedite the efficient use of existing storage facilities and the addition of new at-reactor storage capacity. Activities at the Idaho Engineering Laboratory (INEL) are pertinent to the following objectives: A cooperative demonstration program with the private sector to develop dry storage technologies that the Nuclear Regulatory Commission (NRC) can generically approve; A cost-shared dry storage research and development program at Federal facilities to collect the necessary licensing data. These items are supported by tasks being performed at the INEL. Research and development programs include the testing of metal storage casks containing either consolidated or intact spent fuel in inert gas atmospheres. The casks, weighing nearly 90,718 kg (100 tons), are fabricated using nodular cast iron or forged carbon steel and contain basket assemblies which provide criticality control and spacing of fuel assemblies in individual cells. Small-scale rod consolidation systems are also being developed.

27483 **Handling and storage of spent nuclear reactor fuel at the Idaho Chemical Processing Plant.** Christensen, A.B.; Hohmann, G.L.; Teuscher, D.R. (Idaho National Engineering Lab., Chemical Processing Plant, Idaho Falls, ID 83401 (USA)). pp 375-382 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Spent fuel storage facilities at the Idaho Chemical Processing Plant (ICPP) are extensive, consisting of two fuel storage basins, drywells, and a dry forced air-cooled vault storage facility. All but the newest storage basin have operated for at least a decade, and the original basin for 36 years, although many improvements have been made to this basin and its water treatment system. A new pool storage area began operation in 1984, without most of the problems inherent in the original basin due to design. Fuels which cannot be processed or which cannot be stored underwater have been stored since the mid-seventies in dry wells or in a forced air-cooled vault. Both of these types of facilities have operated with few problems, although some improvements were added to additional drywells constructed since 1985. A cost estimate shows than even though costs are high for storing fuel in pools, pool storage provides the necessary flexibility and simpler handling for fuels received for reprocessing. Fuels received for storage only are reserved for vault or drywell storage, since that type of storage has lower capital and operating costs, even though handling costs are higher. New unprocessable fuels received for storage will be placed into drywells, which can be built as needed in a short time frame.

27484 **A simplified modeling technique for the thermal analysis of spent nuclear assemblies.** Sanchez, L.C. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM 87185 (USA)). pp 389-396 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC04-76DP00789.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A major design concern of a cask for the transport of spent fuel assemblies is the determination of the maximum fuel pin temperature. Normally the determination of the maximum steady state fuel pin temperature requires the thermal analysis (two-dimensional or three-dimensional) of the cask to be performed in conjunction with the fuel assemblies. This, in general, would require extensive effort and computer time. However, by performing a sensitivity analysis for fuel pin temperature for various boundary conditions it was possible to decouple the heat transfer analysis of the cask from that of the fuel assemblies. This paper presents the scaling law that was obtained for maximum fuel pin temperature as a function of emissivity, heat generation rate and assembly wrapper temperature for hex-shaped fuel assemblies.

27485 **Trupact monitoring and dispatching system.** Tappen, J.J.; Driscoll, K.L.; Adam, J.A.; Olive, R.L. (Westinghouse Electric Corp. (USA)). pp 407-410 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Department of Energy (DOE) currently plans to ship contact-handled (CH) transuranic waste from various DOE facilities throughout the continental United States to the Waste Isolation Pilot Plant in southeastern New Mexico. In order to facilitate the safe and efficient movement of this waste and to monitor vehicle movement and status, the Joint Integration Office developed the TRUPACT Monitoring And Dispatching System (TMADS). The system will utilize both computer and satellite technologies as a means of tracking and communicating with these vehicles.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 27499, 27513

0520 Waste Management

REFER ALSO TO CITATION(S) 27479, 27481, 27529, 27530, 27531, 28202, 28226

27486 **(INIS-mf—11156) Evaluation of flexible membrane liners as long-term barriers for uranium mill tailings. Phase 1.** (Golder Associates, Toronto, Ontario (Canada); Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jul 1984. 583p. NTIS (US Sales Only), PC A25/MF A01. Order Number DE88702336/JAW.

Prepared for the National Uranium Tailings Program.

The National Uranium Tailings Program has commissioned a study to evaluate flexible membrane liners (geomembranes) as long-term barriers for Canadian uranium mill tailings. This study reviews the common liner type and addresses flexible liners (polymeric membranes and asphalt) in detail. Liner fabrication, design, installation, and performance are reviewed. Conceptual designs are presented for basins to accommodate 20 years accumulation of uranium tailings from mills in Elliot Lake and southeastern Athabasca. Nine polymeric and three asphalt liner types have been considered with respect to the physical and chemical environment in the uranium producing areas of Canada. All materials indicate good chemical resistance to uranium wastes but are subject to installation problems.

27487 **(INIS-mf—11157) Practical considerations of pyrite oxidation control in uranium tailings.** (Hester (K.D.) and Associates, Oakville, Ontario (Canada); Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). May 1984. 269p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88702337/JAW.

Prepared for the National Uranium Tailings Program.

The problems posed by the oxidation of pyrite in uranium tailings include the generation of sulfuric acid and acid sulfate metal salts. These have substantial negative impacts on watercourse biota by themselves, and the lowered pH levels tend to mobilize heavy metals present in the tailings the rate of oxidation of pyrite at lower pH levels is catalyzed by sulfur and iron oxidizing bacteria present in soils. No single clear solution to the problems came from this study. Exclusion of air is a most important preventative of bacterial catalysis of oxidation. Bactericides, chemically breaking the chain of integrated oxidation reactions, maintaining anaerobic conditions, or maintaining a neutral or alkaline pH all reduce the oxidation rate. Removal of pyrite by flotation will reduce but not eliminate the impact of pyrite oxidation. Controlled oxidation of the remaining sulfide in the flotation tails would provide an innocuous tailing so far as acidity generation is concerned.

27488 **(INIS-mf—11159) Report on assessment of the mechanism of bacterially assisted oxidation of pyritic uranium tailings.** Halbert, B.B.; Scharer, J.M.; Knapp, R.A. (Senes Consultants, Willowdale, Ontario (Canada)). Jul 1984. 150p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702339/JAW.

Prepared for the National Uranium Tailings Program.

The oxidation of pyritic minerals has been shown to be catalyzed by the presence of iron- and sulphur-oxidizing bacteria. Thiobacillus ferroxidans plays the most significant role in the formation and propagation of acidic conditions. Optimum growth conditions for the T. ferroxidans occurs at a temperature of 35 degrees C and pH of 2 to 3. Bacterially assisted oxidation of pyrite involves both direct and indirect contact mechanisms. The direct contact mechanism entails enzymatic oxidation of the insoluble sulphide moiety. The indirect mechanism involves bacterial oxidation of the dissolved ferrous component to the ferric state. The ferric iron, in turn, acts as the prime oxidant of pyrite and is reduced to ferrous iron. The re-oxidation of the dissolved ferrous component which is catalyzed by bacterial activity, completes the cyclic process. The rate of bacterial oxidation is affected by: the geochemistry and reactivity of the pyritic material; the amount of pyrite present in the waste material and the exposed surface area of the pyritic component; the availability of oxygen and carbon dioxide; the pH and temperature of the leach solution; and the presence (or absence) of organic inhibitors. Of the above factors, oxygen has been frequently identified as the rate limiting reactant in tailings.

27489 **(INIS-mf—11160) Hydrogeochemical studies on WTC uranium tailings lysimeters.** (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. Mining Research Labs.; IEC Beak Consultants Ltd., Mississauga, Ontario (Canada)). Mar 1983. 179p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702340/JAW.

In 1974, Environment Canada initiated a series of tailings lysimeter studies at the Wastewater Technology Centre (WTC) in Burlington, Ontario, to examine the leachability of radionuclides and major constituents (TDS, pH) from uranium mill tailings. In addition, the study attempted to assess the effect of two leachate control methods (chemical fixation and vegetation) upon the characteristics of tailings leachate. In 1982 IEC Beak Consultants Ltd. was retained to conduct additional physical/chemical characterization of the tailings solids and some leachate samples. This information, together with the existing data, was then used to develop a conceptual model with which to try to explain the behaviour of the tailings during the leaching of the lysimeters. The specific tasks undertaken included: multi-parameter analysis of leachates collected from 4 lysimeters over the last 1 1/2 years of operation; physical/chemical characterization of the final lysimeter solids including grain size, bulk density, sulphate and carbonate con-tent; use of Scanning Electron Microscopy (SEM) coupled with X-ray Emission (XRE) spectroscopy, plus Mossbauer spectroscopy to characterize surface precipitates and iron speciation respectively; chemical equilibrium modelling on leachates to estimate controlling species in radioisotope and TDS release.

27490 **(INIS-XN—121) Shallow land disposal of radioactive waste.** (Nuclear Energy Agency, 75 - Paris (France)). 1987. 76p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702390/JAW.

The application of basic radiation protection concepts and objectives to the disposal of radioactive wastes requires the development of specific reference levels or criteria for the radiological acceptance of each type of waste in each disposal option. This report suggests a methodology for the establishment of acceptance criteria for the disposal of low-level radioactive waste containing long-lived radionuclides in shallow land burial facilities.

27491 **(SAND—88-0157C) Summary of site-characterization studies conducted from 1983 through 1987 at the Waste Isolation Pilot Plant (WIPP) site, southeastern New Mexico.** Lappin, A.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880201—25).

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The Waste Isolation Pilot Plant (WIPP) is being excavated at a depth of approximately 655 m in bedded halites. This paper discusses aspects of the general conceptual model significant to both site characterization and performance assessment. The geologic and hydrologic behavior of the WIPP site and vicinity is transient, and has been transient since at least deposition of the Permian Salado Formation containing the underground workings of the WIPP facility. The Salado Formation deforms regionally in response to gravity, but is very low in permeability, except within approximately two meters of the WIPP facility. The Culebra Dolomite Member of the Rustler Formation dominates the hydrology at the WIPP site. Hydrologic measurements, geologic studies, major-element and minor-element distributions in Culebra fluids, and the results of isotopic studies are consistent with the interpretations that, although the Culebra dominates flow within the Rustler at the WIPP site and Rustler karst is not present, there has been limited vertical fluid movement within the Rustler and between the Rustler and the overlying Dewey Lake Red Beds. These same studies are consistent with the interpretation that there has been little or no surficial recharge to the Rustler at the WIPP site for at last 12,000 years. 33 refs.

27492 **(UKN—43) 1986 United Kingdom radioactive waste inventory.** Shepherd, J.; Harrison, J.; McNicholas, P. (UKAEA Risley Nuclear Power Development Establishment). (United Kingdom Nirex, Ltd.; Department of the Environment, London (UK)). Nov 1987. 22p. (DOE-RW—87.088). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753101/JAW.

This report gives information on the radioactive wastes which arise in the United Kingdom, updated to 1 January 1986. It has been compiled from information provided by the principal producers of the wastes, Amersham International plc, British Nuclear Fuels plc, the Central Electricity Generating Board, the South of Scotland Electricity Board, and the United Kingdom Atomic Energy Authority. The report lists the waste types, or streams, which these organisations produce, or will produce, as part of their normal operations or from decommissioning of their plant. For each stream is given the volume (or in a few cases mass) of existing stocks, estimated arisings to the year 2030 (2080 in the case of some decommissioning wastes), specific activity, and conditioning factor (volume change from "raw" waste volume to volume conditioned for disposal). Details of the radionuclide compositions of individual waste streams are separately listed. Waste streams are allocated to one of the three categories High, Intermediate or Low-Level, although this does not necessarily imply any commitment to a particular disposal route. The report includes tables summarising the data, arranged in a hierarchical manner to enable totals to be readily extracted as required. Summary tables of both "raw" and "conditioned" waste volumes are given. Also included are a commentary on the data and important changes from the 1985 inventory, and information on scenarios on which estimates of future arisings are based.

27493 **Basic concepts involved in the leaching of waste forms.** Mendel, J.E. (Battelle, Pacific Northwest Lab., Richland, WA (USA)). pp 15-17 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—).

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

This paper discusses the considerations necessary in leach testing of conditioned and unconditioned wastes. These principles are applicable to both radioactive and hazardous chemical wastes. Mass transfer processes within and around vitreous and crystalline waste forms are described. The effects of leaching on the rates of mass transfer and the importance of simulating disposal site conditions as closely as possible are also addressed.

27494 **Leaching models and modeling considerations for solidified low-level radioactive waste forms.** Dougherty, D.R.; Fuhrmann, M.; Pietrzak, R.F.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). pp 18-21 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—).

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

This paper discusses the factors affecting leaching in solidified low level radioactive wastes (LLW). The contributions of porosity, sorption, ion exchange, and dissolution, as well as the major component of diffusion, are addressed. The accuracy of the leachability index in predicting leaching behavior is also examined. Factors which increase the likelihood of catastrophic failure of waste forms are delineated.

27495 **Applications of systems engineering to civilian radioactive waste management program.** Hale, H.J. (U.S. Dept. of Energy, Office of Civilian Radioactive Waste Management, Washington, DC 20585 (USA)). pp 3-8 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Office of Civilian Radioactive Waste Management (OCRWM) was established under the Nuclear Waste Policy Act of 1982 (NWPA) to carry out the development, deployment, and operation of the Federal Waste Management System (FWMS). The program will require a significant systems engineering effort. While the discipline of systems engineering is well documented, there are various approaches to the discipline appropriate in particular applications. This paper discusses the unique features of the waste management problem and the application of systems engineering to meet the requirements of these features. It must be recognized that the program is in a very early stage and that improvements to both the system and the systems engineering process will naturally emerge.

27496 **Overview of Savannah River plant waste management operations.** Haywood, J.E.; Killian, T.H. (E.I. du Pont de Nemours and Co., Savannah River Plant, Aiken, SC 29808 (USA)). pp 51-54 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC09-76SR00001.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Du Pont Savannah River Plant (SRP) Waste Management Program is committed to the safe handling, storage, and disposal of wastes that result from the production of special nuclear materials for the U.S. Department of Energy (U.S. DOE). High-level radioactive liquid waste is stored in underground carbon steel tanks with double containment, and the volume is reduced by evaporation. An effluent treatment facility is being constructed to treat low-level liquid hazardous and radioactive waste. Solid low-level waste operations have been improved through the use of engineered low-level trenches, and transuranic waste handling procedures were modified in 1974 to meet new DOE criteria requiring 20-year retrievable storage. An improved disposal technique, Greater Confinement Disposal, is being demonstrated for intermediate-level waste. Nonradioactive hazardous waste is stored on site in RCRA interim status storage buildings. Technological advancements will continue to be a major part of the waste management effort at SRP, along with compliance with progressive federal, state, and local environmental legislation.

27497 Legislative impacts on Savannah River waste management operations. Bauer, J.D. (United States Dept. of Energy, Savannah River, Aiken, SC 29808 (USA)). pp 55-58 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Today everyone has to be prepared to meet the challenges presented by new legislative actions. The Savannah River Plant is also impacted by this legislation as the exclusive nature of the Atomic Energy Act slowly erodes. This paper discusses the management of three types of radioactive waste from the production of defense nuclear materials and the impacts of major environmental legislation on the handling of these wastes. The paper briefly discusses the major environmental statutes, covers the statutes impact on the technical processes and, finally, considers the nontechnical impact of the statutes.

27498 Environmental analyses for Savannah River plant waste management activities. Jansen, J.R. (Savannah River Operations Office, U.S. Dept. of Energy, Aiken, SC 29808 (USA)). pp 59-62 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Savannah River Plant (SRP) has been a major installation of the U.S Department of Energy (DOE) for the production of nuclear materials for national defense since the 1950's. Activities at SRP include fuel and target fabrication, reactor operations, fuel reprocessing/material recover, and waste management activities. DOE is preparing analyses of the environmental impacts of ongoing and planned waste management activities for hazardous, low-level radioactive, and "mixed" wastes. The purpose of these analyses is to provide a comprehensive framework in which to evaluate future waste management activities, especially as these activities relate to the protection of groundwater resources. This paper provides an overview of planned waste management actions and the strategy and methodologies being used in preparing environmental impact analyses for these proposed activities.

27499 Impacts and mitigation strategies during and after site characterization. Gale, B.G.; Shaw, L.G. (Office of Civilian Radioactive Waste Management, U.S. Dept. of Energy, Forrestal Building, Washington, DC 20585 (USA)). pp 81-84 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

There are substantial differences in the types of activities that DOE will be carrying out during, as opposed to after, site characterization. There are also substantial differences in the provisions of the Nuclear Waste Policy Act (the Act) for assessing and mitigating socioeconomic impacts during the two periods. This paper discusses, briefly, the differences between the site characterization phase and the repository construction and operation phase, and indicate how those differences may affect impacts and potential mitigation. It also discusses the role of impact assessment and monitoring programs in implementing effective mitigation strategies and the respective roles of DOE and affected parties in carrying out both parallel as well as cooperative efforts to project, identify, avoid and mitigate negative impacts. It concludes that as the level of DOE's site specific activities increases, so should the extent to which it is engaged in close consultation with affected parties about its activities and their potential impacts.

27500 Operational testing of an electrically fired Pu-238 waste incineration process. Holmes, H.; Charlesworth, D.L. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC 29808 (USA)). pp 307-314 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Combustible Pu-238 waste is generated as a result of normal operation and decommissioning activity at the Savannah River Plant and is being retrievably stored at the plant. An electrically fired, two-stage incineration process is being developed to study the feasibility of using incineration to process and recover plutonium from the waste. A prototype incinerator is being tested to assess its capability to be remotely operated and maintained. Technical development is focusing on the following six areas to determine the feasibility of placing the incinerator in radioactive service: continuous feeding, vacuum control, remote operability and mechanical integrity of the system, ash burnout, and life of the belt in the primary incinerator chamber.

27501 The DOE waste acceptance process and preliminary specifications for the defense waste processing facility and the West Valley demonstration project. Chacey, K.A.; Benz, E.F. (DOE Savannah River Operations Office, P.O. Box A, Aiken, SC 29801 (USA)). pp 315-322 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Office of Civilian Radioactive Waste Management (OCRWM) has established a process to identify the minimum acceptable requirements for disposal of high-level wastes in a deep geologic repository. The overall process has been designed to establish generic requirements for any reprocessing facility; however, the first application of the process specifically addresses those facilities which are on schedules for waste form production prior to repository license application. There are currently two facilities which are scheduled to start production prior to submittal of the license application for the first repository. The West Valley Demonstration Project (WVDP) will start hot operations in 1st Qtr, FY 90 and the Defense Waste Processing Facility (DWPF) is scheduled to start hot operations in the 3rd Qtr, FY 90. This paper describes the Waste Acceptance Process used by the Department of Energy (DOE) to establish the required documentation which is used to support the license application, and addresses the rationale for the repository acceptance requirements for the DWPF and WVDP waste forms. The key specifications on the canister and waste form are described. Additionally, information on the radionuclide release property requirements and the role of OCRWM in assessing the waste producers' quality assurance programs is discussed.

27502 HLW compliance plan from a waste producer's perspective. Eisenstatt, L.R.; Chapman, C.C.; Pope, J.M.; Maestas, E. (West Valley Nuclear Services, Co., Inc., West Valley, NY 14171-0191 (USA)). pp 327-334 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

In 1980 the U.S. Congress passed the West Valley Demonstration Project Act which directs the U.S. Department of Energy (DOE) to solidify the High-Level Waste (HLW) stored at West Valley, New York into a form suitable for disposal. The immobilization medium selected is borosilicate glass, and the vitrification process is via the joule-heated, slurry-fed ceramic melter. To ensure that the HLW form generated by the West Valley Demonstration project (WVDP) is suitable for disposal, the DOE implemented the Waste Acceptance Process (WAP), which is developing the Waste Acceptance Preliminary Specifications (WAPS). As part of the

WAP, the WVDP and other waste producers will have to develop several plans and reports of data on its waste form and process. This includes the WVDP Waste Form Description which was issued in July 1986. The Waste Compliance Plan (WCP) described the methods and tests that will be used to demonstrate that the WAPS are met. The WVDP WCP will include discussions on the methodology for determining glass properties, techniques for insuring production of acceptable glass, and performance requirements for canisters. The current WVDP schedule calls for initial production of radioactive waste glass in the Spring of 1989. To meet the requirements of the WAP, the project's WCP must be issued, reviewed, and approved well in advance of this date to allow sufficient time for preparation of all qualification data on waste form characterization.

27503 **Prototypical consolidation demonstration project - Final fuel recommendation report.** Piscitella, R.R.; Paskey, W.R. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415 (USA)). pp 349-352 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Prototypical Consolidation Demonstration (PCD) Project will, in its final phase, conduct a demonstration of the equipment's ability to consolidate actual spent commercial fuel. Since budget and schedule limitations do not allow this demonstration to include all types of fuel assemblies, a selection process was utilized to identify the fuel types that would represent predominate fuel inventories and that would demonstrate the equipment's abilities. The Pressurized Water Reactor (PWR) fuel assemblies that were suggested for use in the PCD Project Hot Demonstration were Babcock and Wilcox (B and W) 15 x 15's, and Westinghouse (WE) 15 x 15's. The Boiling Water Reactor (BWR) fuel suggested was the General Electric (GE) 8 x 8.

27504 **Mock-up fuel for use in testing consolidation equipment.** Williams, K.L. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415 (USA)). pp 353-360 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC07-76ID01570.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Via its Prototypical Consolidation Demonstration Program (PCDP), the Department of Energy is developing fuel consolidation equipment to reduce the storage volume required in national storage facilities, e.g., the Geologic Repositories. In 1989 the equipment will be ready for testing at the Idaho National Engineering Laboratory, using "hot" spent commercial fuel assemblies obtained from utilities. Before the hot testing, however, the equipment must undergo extensive cold tests to prove its readiness. This paper explores some of the goals foreseen for the equipment cold test, and focuses on the necessary features for the mock-up fuel to assure that cold test objectives are met. The better the mock-up fuel simulates actual spent fuel, the more accurate the equipment assessment will be.

27505 **Tank farm processing of high-level waste for the defense waste processing facility.** D'Entremont, P.D.; Walker, D.D. (E.I. du Pont de Nemours and Co., Savannah River Plant, Aiken, SC 29808 (USA)). pp 69-74 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC09-76SR00001.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The high-level radioactive waste that has accumulated at the Savannah River Plant is stored in large, underground steel tanks. Programs to remove the waste from the storage tanks and immobilize the radioactivity in borosilicate glass in the Defense Waste processing Facility (DWPF) are currently in the construction phase. Much of the processing of the waste prior to vitrification is accomplished in the waste storage areas (tank farms). Tank farm processing includes resuspension and washing of the insoluble (sludge) waste, dissolution and decontamination of soluble (salt) waste, and waste transfer between the tanks and operations areas. The overall program for handling the waste in the tank farms, the research program that supports it, and the major concerns with implementing the program are described.

27506 **The defense waste processing facility: A status report.** Cowan, S.P.; Fulmer, D.C. (U.S. Dept. of Energy, Savannah River Operations Office, Aiken, SC 29808 (USA)). pp 75-80 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Defense Waste Processing Fascility (DWPF) will be the nation's first production scale facility for immobilizing high-level waste for disposal. It will also be the largest facility of its kind in the world. The technology, design, and construction efforts are on schedule for "hot" operation in fiscal year 1990. This paper provides a status report on the DWPF technology, design, and construction, and describes some of the challenges that have arisen during design and construction.

27507 **Retrievability considerations and their impact on the design of vertical emplacement and retrieval equipment for a repository in salt.** Nair, B.R.; Bahorich, R.J. (Westinghouse Electric Corp., Nuclear Waste Dept., Madison, PA 15663-399 (USA)). pp 261-270 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The current design concept for the disposal of nuclear high level waste packages in a repository in salt is based on the emplacement of individual packages in vertical boreholes in the underground mine floor. A key requirement is that the waste packages be capable of being retrieved during the last 26 years of the 76-year repository operating period. The unique design considerations relating to the retrieval of waste packages emplaced in bedded salt are presented in this paper. The information is based on the experience developed during the design of vertical emplacement and retrieval equipment in support of the Sandia Defense High Level Waste experiments at the Waste Isolation Pilot Plant. Also included are the impact of retrievability on the design of the equipment, the special salt cutting technology that was developed for this application, and a description of the equipment.

27508 **TRUSYSTEM - A computerized system for the management of defense transuranic waste.** Adam, J.A.; Olive, R.L. II; Vacarro, H.S.; Driscoll, K.L. (Rockwell International (USA)). pp 289-292 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The U.S. Department of Energy (DOE) is embarking on a program to dispose of defense transuranic waste in the Waste Isolation Pilot Plant (WIPP) near Carlsbad, NM. In order to ensure that WIPP receives the waste at the required rate, the careful management of a logistic system involving numerous DOE facilities and specialized waste transports is required. TRUSYSTEM is being used in the design and operation of this complex system. TRUSYSTEM consists of a computerized database (PRIMS), a system simulation program (TRUSIM), and software for the monitoring and dispatching of waste transports (PHOENIX). This system designed to operate on the new generation of microcomputers, is being written in machine independent code (FORTRAN and "C"). It is easily maintained and can be moved between different types of computers. TRUSYSTEM resides entirely within computer memory. This provides the speed necessary for real-time operations.

27509 **Acceptance criteria considerations for miscellaneous wastes.** Irvine, A.R.; Forsberg, C.W. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831 (USA)). pp 339-348 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC05-84OR21400.

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Extensive preparations are under way for the geologic disposal of conventional high-level waste and spent fuels. However, the nonconventional wastes, whose volume is only a small fraction of that of conventional high-level wastes and which have greater activity levels than are permitted for shallow-land burial, may be routed to a geologic repository. This paper describes the latter wastes and presents two approaches whereby their disposal costs might be minimized while satisfying the intent of the regulations. The approaches are: (1) elimination of the 300- to 1000-y-life container, which might be justified in the absence of a significant thermal pulse (achievable by predisposal decay and/or dispersal in the repository), and (2) employment of a more effective migration barrier around the waste form to compensate for conservatively estimated, as opposed to conclusively determined, performance of the waste form as a barrier to the release of radioactivity.

27510 **How many geologic repositories will be needed.** Evans, T.J.; Halstead, R.J. (Geological and Natural History Survey, Univ. of Wisconsin Extension (USA)). pp 33-42 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

DOE's postponement of site-specific work on the second repository program had rekindled debate over the number of geologic repositories needed for disposal of high level radioactive waste. The multiple repository approach grew out of the March, 1979 IRG report, which recommended co-disposal of civilian and defense HLW in a system of regional repositories. The multiple repository approach was adopted by DOE, and incorporated in the Nuclear Waste Policy Act passed by Congress in December, 1982. Since the late 1970's, the slower than anticipated growth of the nuclear power industry has substantially reduced earlier estimates of the amount of civilian spent fuel which will require geologic disposal. Reactors currently in operation (78.5 GWe) and reactors in the construction pipeline (28 GWe) are expected to discharge about 103,200 MTU of spent fuel by the year 2036, assuming no increase in fuel burnup rate. By the year 2020, defense high level radioactive wastes equivalent to as much as 27,000 MTU could require geologic disposal. Small amounts of high level waste from other sources will also require geologic disposal. Total disposal requirements appear to be less than 140,000 MTU. The five sites nominated for the first repository, as well as hypothetical sites in granite, the host rock under primary consideration for the second repository, all appear capable of accommodating up to 140,000 MTU.

27511 **Public confidence in radioactive waste disposal.** Easterling, J.B. (Policy and Institutional Planning Div., United States Dept. of Energy, Washington, DC 20585 (USA)). pp 43-46 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

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World scientific advances have convinced government authorities that the basic disposal technology is available to permanently and safety dispose of nuclear high-level solid waste in deep geologic formations. However, the public is not convinced. Broader citizen involvement and confidence in nuclear waste disposal plans and programs is needed if the nation is to be successful in permanent isolation of such waste. This paper explores ways to improve public information, education, and participation in order to enhance public confidence.

27512 **Concept development for saltstone and low level waste disposal.** Wilhite, E.L. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC 29808 (USA)). pp 63-68 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC09-76SR00001.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A low-level alkaline salt solution will be a byproduct in the processing of high-level waste at the Savannah River Plant (SRP). This solution will be incorporated into a cement wasteform, saltstone, and placed in surface vaults. Laboratory and field testing and mathematical modeling have demonstrated the predictability of containment release from cement wasteforms. Saltstone disposal in surface vaults will meet drinking water standards in shallow groundwater at the disposal area boundary. Planning for new Low-Level Waste (LLW) disposal could incorporate concepts developed for saltstone disposal.

27513 **The MRS task force: Economic and non-economic incentives for local public acceptance of a proposed nuclear waste packaging and storage facility.** Peelle, E. (Oak Ridge National Lab., Oak Ridge, TN 37831 (USA)). pp 117-122 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC05-84OR21400.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A joint Oak Ridge-Roane County citizen task force (TF) evaluated the Department of Energy's (DOE) proposal to site a Monitored Retrievable Storage facility in Tennessee in terms of environmental, transportation and socioeconomic impacts. The case study examines how the TF used mitigation, compensation, and incentives (economic and non-economic) to address the problem of distrust of DOE and to change the net local impact balance from negative to positive. Intensive group interaction during their investigations and development of trust within the TF led to consensus decisions on safety and conditional acceptance. DOE accepted most of the TF conditions after informal negotiations. The siting process was stopped by extensive state-wide opposition resulting in legal challenge by the state and vetoes by the governor and state legislature.

27514 **Application of commercial exploration techniques to site selection and characterization.** Brewer, W.A. (Dept. of Ecology, State of Washington (USA)). pp 137-140 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

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Since 1976 the U.S Department of Energy has conducted intensive geologic studies of the Hanford Nuclear Reservation in south-central Washington. With passage of the Nuclear Waste Policy Act of 1982 the process of search for a geologically suitable waste repository site became more structured, and it has been subject to outside review by the state, affected Indian tribes and other federal agencies, notably the Nuclear Regulatory Commission and the U.S Geological Survey. This paper contrasts the USDOE approach with that of the mining and petroleum industries, highlighting fundamental differences in philosophy and techniques. It is proposed that the principle of "condemnation," which is fundamental in commercial exploration methods, could greatly benefit the USDOE siting program, which by comparison has been slow, costly and not very productive.

27515 **Performance assessment for a nuclear waste repository - The WIPP experience.** Chaturvedi, L.; Chapman, J.B.; Neill, R.H.; Channell, J.K. (Environmental Evaluation Group, State of New Mexico, P.O. Box 968, Santa Fe, NM 87503 (USA)). pp 141-146 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

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Performance Assessment to show compliance with the standards for a nuclear waste repository requires thorough site characterization and understanding of potential pathways for a breach of the repository. Although the Waste Isolation Pilot Plant (WIPP) project will not be licensed by the Nuclear Regulatory Commission (NRC) under 10 CFR 60, it is subject to the Environmental Protection Agency "Standards for the Management and Dispoosal of Spent Nuclear Fuel, High Level and Transuranic Radioactive Wastes" (40 CFR Part 191). NRC has incorporated 40 CFR 191 into 10 CFR 60 and requires the demonstration of compliance before construction of the high level waste (HLW) repositories can begin. The Environmental Evaluation Group (EEG) of the State of New Mexico has independently evaluated the WIPP project since 1978 and believes that compliance for WIPP should be demonstrated prior to emplacement of waste for disposal. The U.S. Department of Energy schedule calls for the arrival of waste at WIPP in late 1988. DOE considers WIPP to be a research and development facility for the first 5 years of operation, and believes that compliance with the EPA Standards need not be demonstrated until after the decision is made not to retrieve the waste. It appears that DOE's mission plan for the first HLW repository has not provided sufficient time to resolve the site characterization issues and complete the performance assessment for each of the three sites before submitting a license application to NRC.

27516 **The significance of tectonic events and processes on the long-term isolation of high-level radioactive wastes.** Kimball, J.K.; Jackson, R.E.; Jelacic, A.J.; Rhoderick, J. (Roy F. Weston, Inc., Washington, DC (USA)). pp 147-152 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

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The development of tectonic scenarios for a high-level radioactive waste repository will depend on both the probability of occurrence of a tectonic event and the relationship between the tectonic event and those factors which may be important in assessing repository performance. Estimation of probability of occurrence requires use of as much of the available information as possible regarding the current tectonic regime of each prospective site. For those events which are found to be creditable, judgments are required as to how the tectonic events could impact hydrologic, geochemical or mechanical performance factors. Example generic relationships between performance factors and tectonic events are presented to show the type of information that will be important in developing tectonic scenarios.

27517 **Site characterization information needs for a high-level waste geologic repository.** Gupta, D.C.; Nataraja, M.S.; Justus, P.S. (Nuclear Regulatory Commission, Div. of Waste Management, Washington, DC 20555 (USA)). pp 165-168 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

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At each of the three candidate sites recommended for site characterization for High-Level Waste Geologic Repository development, the DOE has proposed to conduct both surface-based testing and in situ exploration and testing at the depths that wastes would be emplaced. The basic information needs and consequently the planned surface-based and in situ testing program will be governed to a large extent by the amount of credit taken for individual components of the geologic repository in meeting the performance objectives and siting criteria. Therefore, identified information to be acquired from site characterization activities should be commensurate with DOE's assigned performance goals for the repository system components on a site-specific basis. Because of the uncertainties that are likely to be associated with initial assignment of performance goals, the information needs should be both reasonably and conservatively identified.

27518 **The siting and licensing role of the exploratory shaft facility.** Stucker, D.; Montgomery, J.E. (Office of Civilian Radioactive Waste Management, U.S. Dept. of Energy, Washington, DC 20585 (USA)). pp 175-180 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

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The test facility that will provide the access and support for in-situ testing and monitoring activities at each of the three candidate horizons for the first repository is called the exploratory shaft facility (ESF). Laboratory data and surface findings will be combined with the in-situ test activities to allow final assessment for site determination and verification of design parameters for repository design and license application. The ESF will be used to collect data for repository site selection, for the validation of parameters in the designs of the repository and the waste package, for confirmatory testing in support of the license application, and for initiating performance confirmation.

27519 **Selection of site-characterization tests in the exploratory-shaft facility at three candidate repository sites.** Voss, C.F.; Nelson, J.W.; Rhoderick, J.E. (Pacific Northwest Labs., Washington, DC (USA)). pp 169-174 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

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Various in-situ tests will be conducted in the exploratory-shaft facilities at each of the candidate repository sites. This paper compares preliminary test plans for the Nevada, Washington, and Texas sites, identifying differences and similarities among them. The final test plans will reflect an approach recently adopted by the Department of Energy (DOE) to address each of the siting and licensing requirements in Federal regulations for geologic repositories. This approach is discussed, and the rationale for determining parameter needs and linking those needs to the test plans is presented. An example of how this rationale is used to identify specific tests is provided.

27520 **NRC experiences in hydrocoin: An international project for studying ground-water flow modeling strategies.** Nicholson, T.J.; McCartin, T.J.; Davis, P.A.; Beyeler, W. (Waste Management Branch, Div. of Engineering Safety, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555 (USA)). pp 201-208 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The "Hydrologic Code Intercomparison Study" (HYDROCOIN) is an international study designed to investigate various ground-water modeling strategies used to analyze the performance of high-level waste disposal sites. The various ground-water models considered are to be used for safety assessments of low- and high-level radioactive waste facilities. The work completed to date has been simulations of test cases developed to verify and validate the numerical codes chosen by the individual project teams. Twenty-five computer codes were tested during the verification phase of the HYDROCOIN effort. To test the codes, seven cases, which include both saturated and unsaturated conditions in both fractured and porous media, were simulated. Simulation results from the 22

international project teams were then intercompared as well as compared to analytical solutions wherever possible. Current work deals with validation of ground-water flow models. After an exhaustive background study, it was determined that validation of complex ground-water flow models based upon a comprehensive data base is presently not possible. Therefore, the test cases accepted for the validation phase are for relatively simple ground-water flow systems where comparison of the simulation results are with limited field or laboratory data. Additionally, work dealing with uncertainty and sensitivity analyses has recently begun. This work explores appropriate ways of using hydrogeologic models in performance assessment by examining uncertainties in the conceptual models and the hydrogeologic parameters. Valuable lessons have been learned from the HYDROCOIN experiences in understanding limitations of the models, available data sets, and modeling strategies.

27521 **Performance of bentonite/crushed rock borehole plugs.** Williams, J.R.; Daemen, J.J.K. (Loma Linda Univ., Dept. of Geological Sciences, Riverside, CA 92515 (USA)). pp 213-222 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A mixture of crushed rock and bentonite is being considered as backfill and sealant for high-level nuclear waste repositories. Many variables affect the hydraulic conductivity of such a mixture, including the size and shape of the rock particles, method of mixing, water content and density of the clay, and the weight ratio of rock to clay. Mixtures of crushed basalt and bentonite have been tested to determine the relative effects of these variables. Two types of permeameters are used, 20 cm diameter stainless steel permeameters and 10 cm diameter clear PVC permeameters. Plugs are installed as a single lift or in many lifts; the water content of the clay ranged from air-dry (in most cases) to as high as 200%. Preliminary results show that a mixture of 75% crushed basalt and 25% bentonite has a hydraulic conductivity between 1 x 10/sup -9/ cm/s and 2.5 x 10/sup -8/ cm/s. In some cases, preferential flow paths have developed (possibly as a result of the montmorillonite washing out of the crushed rock matrix), giving hydraulic conductivities as high as 1 x 10/sup -4/ cm/s. Other ratios of rock to clay have similar bimodal results. The probability of failure is decreased by including a higher percentage of clay, crushing the rock finer, and evenly mixing the crushed rock and clay.

27522 **The operational status of WIPP.** Chiquelin, W.R.; Halverson, T.W.; De Jong, V.J.; Patrick, L.A. (Westinghouse Electric Corp., Carlsbad, NM 88220 (USA)). pp 223-226 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Waste Isolation Pilot Plant (WIPP), a waste facility for the disposal of defense generated transuranic (TRU) waste, is almost structurally complete. The WIPP, located in southeastern New Mexico, is managed and operated by the Waste Isolation Division of the Westinghouse Electric Corporation for the U.S. Department of Energy. The plant is presently undergoing startup testing, including operational demonstrations of waste handling equipment and processes. The current status of WIPP's waste handling capacity, constraints, and plans are of major interest to the waste community, due to the significant technological advances of the Project. Information gained through the operation of the plant will be invaluable, since both the commercial and defense implications of the WIPP waste management programs are far-reaching in terms of future radioactive waste disposal. This paper provides the latest WIPP construction status, operational plans, start-up schedule, and significant findings. The capabilities and constraints of WIPP waste handling and storage are discussed in detail, and topics involving WIPP preparation for waste receipt in October 1988 (including the waste handler training and qualification program) are also addressed.

27523 **WIPP R and D in situ test program.** Tyler, L.D. (Experimental Programs Div. 6332, Sandia National Labs., Albuquerque, NM 87185 (USA)). pp 227-236 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC04-76DP00789.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Waste Isolation Pilot Plant (WIPP) is a Department of Energy (DOE) RandD Facility for the purpose of developing the technology needed for the safe disposal of the United States' defense-related radioactive waste. The in situ test program focus is to provide the models and data to demonstrate the facility performance for isolation of waste at WIPP. The program is defined for the WIPP sealing system, thermal-structural interactions and waste package performance. A number of integrated large-scale underground tests have been operational since 1983 and are ongoing. The tests address the issues of both systems design and long-term isolation performance of the WIPP repository.

27524 **Numerical thermal modeling of the WIPP in situ room A1 simulated DHLW experiments.** Beraun, R.; Molecke, M.A. (Sandia National Labs., Albuquerque, NM 87185 (USA)). pp 245-254 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC04-76DP00789.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The intent of this paper is to present the results of transient thermal analyses performed to determine temperatures in the near- and far-field, in the vicinity of a defense high-level waste container and an emplacement drift. Three different drift/canister configurations were modeled; one containing nitrogen gas, another crushed salt, and the last bentonite/sand as the backfill material between the container and the borehole wall. The test containers are a non-reference overpack design, consisting of a 2.5 cm thick mild steel container either with or without a thin overwrap of TiCode-12. The thermal conductivity of the salt formation was assumed to be temperature dependent while both the density and specific heat were assumed to be constant. The analyses were undertaken using a four node, bilinear, quadrilateral finite element nonlinear heat transfer program, COYOTE, and a finite difference thermal analyzer code, SINDA. Results presented include typical temporal and spatial distributison of temperature. The near-field temperature results obtained from the numerical modeling compare well with measured experimental data.

27525 **Recent developments in the conceptual geologic and hydrologic understanding of the WIPP site, Southeastern New Mexico.** Lappin, A.R. (Sandia National Labs., Div. 6331, Albuquerque, NM 87185 (USA)). pp 255-260 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Hydrologic and geochemical characterization of the WIPP site has progressed significantly since the 1980 WIPP Final Environmental Impact Statement. In 1980, the entire Rustler Formation was modeled as a single hydrologic unit, assumed to be isotropic, single-porosity, and completely confined. Variability within the Rustler was evaluated only on the basis of testing at individual wells. In the 1983 WIPP Site and Preliminary Design Validation effort, the Salado Formation, in which the WIPP facility is being constructed, was assumed to be anhydrous, except for fluid inclusions and mineralogically bound water. Recent hydrologic and tracer testing at the WIPP indicates: 1) The local importance of dual-porosity behavior in hydraulic response and transport in parts of the Culebra Dolomite Member of the Rustler Formation; 2) the presence of distinct high- and low-transmissivity regions within the Culebra; and 3) the possible importance of vertical fluid flow within the Rustler. Recent analyses indicate that fluids encountered

in the WIPP facility and in experimental brine-migration studies are grain-boundary fluids, chemically distinct from fluid inclusions. Fluid-inclination compositions appear to have been determined shortly after the halite deposition. Because of the times required for diagenetic reactions controlling their compositions, the grain-boundary fluids within the Salado probably have a residence time of several million years.

27526 Development and operation of the conversion/solidification process for the CEUSP project. Hall, R.; Collins, E.D.; Johnson, J.K.; Krichinsky, A.M.; McGinnis, C.P.; Patton, B.D.; Shor, J.T.; Vedder, R.J. New York, NY; American Institute of Chemical Engineers (1987). 8p. (CONF-870822—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

Technical Paper 43B.

During the early 1960s, the U.S. Atomic Energy Commission (AEC) sponsored a test irradiation of a ThO/sub 2/-UO/sub 2/ fuel core in the Consolidated Edison Indian Point-1 Reactor at Indian Point, New York. The test generated — 1000 kg of highly radioactive and fissile uranium (containing — 75% /sup 235/U, — 10% /sup 233/U, and — 140 ppm /sup 232/U). In 1968, the AEC also sponsored reprocessing of the irradiated fuel at the Nuclear Fuel Services Plant in West Valley, New York, to recover the fissile uranium. The uranium nitrate product solution resulting from the reprocessing operations was sent to ORNL for storage. Soluble poisons (cadmium nitrate and gadolinium nitrate) were added to ensure subcriticality of this solution during its storage in a specially prepared 18,900-L (5000-gal) Thorium Reactor Uranium Storage Tank (TRUST), located at the Radiochemical Processing Plant (RPP). When no use for the uranium had become apparent after several years of storage, a project called the Consolidated Edison Uranium Solidification Program (CEUSP) was initiated in the late 1970s to solidify the material for safe long-term storage. A unique conversion/solidification process and the equipment to carry it out were conceived, developed, and operated by Chemical Technology Division personnel.

27527 In situ vitrification - A potential remedial action technique for hazardous wastes. Fitzpatrick, V.F.; Buelt, J.L.; Oma, K.H.; Timmerman, C.L. (Pacific Northwest Lab., Richland, WA (USA)). pp 191-194 of Management of uncontrolled hazardous waste sites. Silver Spring, MD; Hazardous Materials Control Research Institute (1984). (CONF-841137—). Contract AC06-76RL01830.

From 5. national conference on management of uncontrolled hazardous waste sites; Washington, DC, USA (7 Nov 1984).

In situ vitrification (ISV) is an innovative technology being developed as a potential method for stabilizing transuranic (TRU) contaminated wastes in place. Although the process is being developed for TRU contaminated wastes, it is envisioned that the process could also be applied to hazardous chemical wastes. In situ vitrification (ISV) is the conversion of contaminated soil into a durable glass and crystalline wastes form through melting by joule heating. The technology for in situ vitrification is based upon electric melter technology developed at the Pacific Northwest Laboratory (PNL) for the immobilization of high-level nuclear waste. In situ vitrification was initially tested by researchers at PNL in August, 1980 (U.S. Patent 4,376,598). Since then, ISV has grown from a concept to an emerging technology through a series of 21 engineering-scale (laboratory) tests and 7 pilot-scale (field) tests. A large-scale system is currently being fabricated for testing. The program has been sponsored by the U.S. Department of Energy's (DOE) Richland Operations Office for potential application to Hanford TRU contaminated soil sites. A more detailed description outlining the power system design and the off-gas treatment system follows.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 27491, 27498, 27499, 27513

27528 A methodology for chemical hazards analysis at nuclear fuels reprocessing plants. Durant, W.S.; Perkins, W.C. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC 29808 (USA)). pp 6.85-6.96 of Proceedings of the international symposium on preventing major chemical accidents. Woodward, J.L. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870289—).

From International symposium on preventing major chemical accidents; Washington, DC, USA (3 Feb 1987).

The Savannah River Laboratory employs a formal methodology for chemical hazards analysis primarily for use in the risk assessment of its nuclear fuels reprocessing plants. The methodology combines interactive matrices for reactions of available materials, fault tree analysis, human factors, and extensive data banks on the operating history of the plants. Examples illustrate the methodology and a related data bank.

0540 Health And Safety

REFER ALSO TO CITATION(S) 27496, 27511, 27528

27529 Salt repository underground waste handling design considerations. Cole, L.T. (Westinghouse Electric Corp., Carlsbad, NM 88220 (USA)). pp 271-276 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

This paper discusses the lessons learned during the design, operational planning, and early startup phases of underground waste handling operations at WIPP. The unique nature of planning and conducting a transuranic waste disposal operation in a deep geologic salt formation offers many unusual circumstances to equipment and operating personnel. Normal nuclear considerations such as limiting personnel radiation exposures, handling large and heavy shielding casks, and conducting precise operational sequences are impacted by the new working environment of the mine. Some aspects of these additional design considerations are discussed.

27530 Experience of the New Mexico EEG in evaluating the WIPP project. Neill, R.H. (Environmental Evaluation Group, State of New Mexico, Santa Fe, NM 87503 (USA)). pp 283-286 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Environmental Evaluation Group (EEG) of the State of New Mexico has been evaluating the public health and safety aspects of the Waste Isolation Pilot Plant (WIPP) project since 1978. The WIPP project is planned to be the first geological repository for nuclear wastes in the U.S.A. and will be used for the disposal of transuranic (TRU) waste generated by the nation's defense program as well as for experimental storage of defense high level waste (HLW). Since WIPP will not be licensed by the Nuclear Regulatory Commission (NRC), EEG is the only agency that has independently evaluated the project. The EEG's evaluation has resulted in a more thorough site characterization, relocation of the repository, better design of the operations and the monitoring systems and better design of the transportation cask. These are significant accomplishments for a group with no licensing authority and for a state with no veto power to stop the project, but working only under a Consultation and Cooperation Agreement with the U.S. Department of Energy.

27531 **Radiation doses resulting from variations in spent fuel/waste management systems without monitored retrievable storage.** Schneider, K.J.; Pelto, P.J.; Lavender, J.C.; Daling, P.M.; Fecht, B.A. (Pacific Northwest Lab., Richland, WA 99352 (USA)). pp 383-388 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

This paper presents results of analyses of radiological dose impacts on the public and the workers of nine potential transportation-related changes in the operation of a hypothetical high-level waste management system that does not include a Monitored Retrievable Storage (MRS) facility. The analyses were performed for the U.S. Department of Energy (DOE) to determine if some of the benefits proposed for the improved performance waste management system (one with an MRS facility) could also benefit the authorized system (one without an MRS facility). The study showed that most of the alternatives evaluated would reduce the radiation doses to the public and the workers. Of the alternatives evaluated, the primary means for reducing these radiation doses is to increase the capacity of the transportation casks.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 27526, 27924

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 27479, 27496, 27497, 27515, 27519, 27526

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

REFER ALSO TO CITATION(S) 27621, 27850, 27884

27532 **(AECL—8829) Industrial demonstration of computer assisted tomography. Three-dimensional mapping of a motorcycle carburetor.** Lupton, L.R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Sep 1985. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702207/JAW.

Computerized tomography (CT) is a nondestructive testing technique for generating quantitative density (linear attenuation coefficient) maps of a cross section through an object. By using a series of parallel tomographic images taken at different elevations, a three-dimensional (3-D) map of the object can be obtained. To demonstrate the power of tomography, a 3-D region of a motorcycle carburetor has been imaged using twenty-four parallel two-dimensional images. From these data, new images in planes orthogonal to the original planes have been generated, thereby improving the user's ability to visualize the position of components within the carburetor. The data have also been used to demonstrate the relationship between tomography and radiography.

27533 **(AECL—8836) Computed tomography on a defective CANDU fuel pencil end cap.** Lupton, L.R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Sep 1985. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702208/JAW.

Five tomographic slices through a defective end cap from a CANDU fuel pencil have been generated using a Co-60 source and a first generation translate-rotate tomography scanner. An anomaly in the density distribution that is believed to have resulted from the defect has been observed. However, with the 0.30 mm spatial resolution used, it has not been possible to state unequivocally whether the change in density is caused by a defect in the weld or a statistical anomaly in the data. It is concluded that a microtomography system, with a spatial resolution in the range of 0.1 mm, could detect the flaw.

27534 **Gadolinium-153 production at the Oak Ridge National Laboratory.** Ramey, D.W. New York, NY; American Institute of Chemical Engineers (1987). 22p. (CONF-870822—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

Technical Paper 43E.

Gadolinium-153 production at the Oak Ridge National Laboratory (ORNL) involves the neutron irradiation of natural europium oxide (47.8% /sup 151/Eu, 52.2% /sup 153/Eu). This target material undergoes a series of neutron captures and radioactive decays to produce the desired /sup 153/Gd product. Several undesirable europium isotopes (/sup 152/Eu, /sup 154/Eu, and /sup 156/eu) are also produced during this irradiation process. Recent technical advances and other improvements in the radiochemical processing of this isotope have allowed ORNL to increase production by more than sevenfold. A newly developed electrochemical process has allowed the separation of the bulk of undesirable europium isotopes and has also affected a more efficient use of high-pressure ion exchange to achieve a final product radiochemical purity >99.999%. Specific activities >60 Ci/g of gadolinium oxide and product specific yields >2.9 Ci/g of irradiated europium oxide have been produced. Use of unique glove box manipulators and special equipment designed at ORNL have allowed final source fabrication to keep pace with the increased production rate while minimizing the radiation exposure to operating personnel.

27535 **Electron beam sterilization using an integrated systems approach.** Johnston, B.S.; Thompson, C.C. (Radiation Dynamics, Inc., Melville, NY (USA)). pp 982-984 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The sterilization of medical disposables is a complex process and requires a sophisticated system to meet today's stringent requirements. Such a system is in use today using electron beam sterilization from a Dynamitron accelerator. The process system components are described as is their functionality as part of an integrated system. Certain information is omitted to observe the confidentiality of the user.

27536 **High-power selfshielded electron processors and their application to stack gas treatment.** Hiley, J.; Frutiger, W.A.; Nablo, S.V. (Energy Sciences Inc., Woburn, MA (USA)). pp 985-989 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The increasing industrial demands for large width (approximately 2 m), high dose rate (1 Mrad at 1500 m/min) electron beam machinery has led to a relatively rapid improvement in this field over the past several years. Selfshielded machinery capable of up to 1000 mA of current at 300 kV is now in commercial use, and the essential features of these designs are presented. A variety of product handling geometries for use with these accelerators has been developed for processes involving flexible web, rigid sheet, and three-dimensional objects in both the polymerization and sterilization applications. One of the major power-intensive processes to which these machines are currently applied is that of the reduction of pollutants (NO/sub x/, SO_2, etc.) in the flue gas from fuel combustion - particularly those fossil fuels used in power production. The preferred technique utilizes the treatment of the ammoniated gas at modest dose levels (0.5 - 2.0 Mrads) to enhance the formation of ammonium salts which are then removed from the gas stream by conventional filtration. Some results from a 180 kW x 300 kV pilot installation in Karlsruhe, Federal Republic of Germany are presented.

27537 Detection of scattered x-rays from an electron linac in a borehole. Becker, A.J.; Boyce, J.R.; Corris, G.W.; King, G. III; Bramblett, R.L. (Schlumberger-Doll Research, Ridgefield, CT (USA)). pp 995-998 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An electron linac has been used as a borehole x-ray generator in determining geological density. A detection system has been developed for the linac and measures the amount of Compton scattering over a variety of paths in the formation. Since the linac is pulsed and has a low duty factor, the detectors are designed to respond to the instantaneous radiation energy rather than to the count-rate. In some cases, more than a GeV of energy can enter a detector during a linac pulse. Both NaI detectors and xenon-filled ion chambers are used. Energy discrimination is accomplished by x-ray filtering. Since all detectors receive signals simultaneously, a sample-hold and multiplexing system is employed. Gain drifts of the NaI detectors are monitored with weak ^{137}Cs sources. NaI afterglow may influence the gain monitoring. Borehole compatibility requires high-temperature operation and ruggedization. This detection system has been used downhole to measure formation density.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 27539

27538 (FRNC-TH—3025) Contribution to the study of new processes for hydrogen production, purification and storage. Manaud, J.P. (Bordeaux-1 Univ., 33 - Talence (France)). Jul 1984. 134p. (In French). NTIS (US Sales Only), PC A07/MF A01;1. Order Number DE88752587/JAW.

The thermodynamic evaluation of two thermochemical cycles for water decomposition using respectively a chlorine cycle and a sulfur cycle shows that irreversibility from separation and heat transfer decreases process yields. For hydrogen purification a comparative study of nickel, monel and Pd 77-Ag23 alloy permeation characteristics shows that the last alloy is the more performing, althougn nickel can be used in thin diffusers. The reactivity of the alloy Ce Mg/sub 12/ with hydrogen containing a small amount of impurities such as nitrogen, oxygen and water vapor shows that for a great number of absorption-desorption cycles hydrogen storage characteristics are slightly altered. Analysis of desorbed hydrogen shows that performance of this material is limited.

0802 Storage

REFER ALSO TO CITATION(S) 27538

0804 Marketing And Economics

27539 (FRNC-R—201) Hydrogen: Technical and economical comparison of different methods of production. Salvadori, A.;Marque, D. (Gaz de France, 75 - Paris). [1988]. 58p. (In French). NTIS (US Sales Only), PC A04;3. Order Number DE88770124/JAW.

Hydrogen production from hydrocarbons (catalytic reforming, partial oxidation and refinery gas processing), coal gasification (Lurgi, Koppers-Totzek, Winkler, Texaco processes and in-situ gasification), water decomposition (electrolysis, thermolysis, thermochemical cycles and solar energy conversion) are reviewed. Hydrogen purification for carbon oxide conversion, sulfur and methane removal is examined. Cost of hydrogen production is estimated and compared with data now available, uncertainties arise from the difficulty to forecast coal price evolution and investment for water electrolysis. For a market developed enough hydrogen could be produced both by coal gasification and water electrolysis.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 27873

27540 (PB—88-165790/XAB) US production of manufactured gases: assessment of past disposal practices. Harkins, S.M.; Truesdale, R.S.; Hill, R.; Hoffman, P.; Winters, S. (Research Triangle Inst., Research Triangle Park, NC (USA)). Feb 1988. 410p. NTIS, PC A18/MF A01.

Former sites of gas manufacture present problems for remediation and reuse of the sites. In some cases, polluted groundwater and surface waters are near the sites. This study examines the history of the manufactured-gas industry of the United States, its production processes, disposal trends, waste toxicity, methods of site investigation, and the current status of manufactured-gas sites. The report is intended as a guide to those who are examining and evaluating manufactured-gas sites for either environmental risks or possible remediation. Six manufactured-gas sites and one spent oxide disposal area were visited during the project, and case studies were prepared for six former gas-manufacturing sites, two byproduct tar-utilization facilities, a creosoting plant and a coal-tar processor. The current status of manufactured-gas sites in the United States was determined by contacting State and regional environmental officials and by discovering how their regions were treating manufactured-gas sites.

27541 (PB—88-173117/XAB) GRI's (Gas Research Institute's) methane from biomass and wastes subprogram. Status report 1983. Topical report. (Gas Research Inst., Chicago, IL (USA)). Dec 1983. 35p. (GRI—83/0086). NTIS, PC A03/MF A01.

This 1983 status report discusses ongoing and planned activities in GRI's Biomass and Wastes Subprogram. Among the wastes being examined as potential feedstocks for SNG are municipal solid wastes, landfill, sewage sludge, and certain industrial and agricultural wastes. Crops being examined are sorghum, napier grass, water hyacinth, hybrid poplar, and certain aquatic weeds. A major focus of the subprogram is to apply newly developed advanced biotechnologies to potential biomass feedstocks and conversion processes. Research and development (R&D) activities in the subprogram are subdivided into two project areas: Methane From Biomass and Methane From Wastes. Presented are objectives and goals, accomplishments, strategy and basis for each project area, and a status review sheet for projects within the project area.

27542 (PB—88-181326/XAB) Chemical Process Research Department substitute-natural-gas supply R and D status report. December 1987. (Gas Research Inst., Chicago, IL (USA)). Dec 1987. 100p. (GRI—87/0356). NTIS, PC A05/MF A01.

See also report dated December 1986, PB—88-113048.

This document discusses the status of ongoing and planned substitute natural gas supply-related research activities in GRI's Chemical Process Research Program as described in the 1988 GRI plan. The program is part of a broad research program to develop the technologies for providing new gas supplies from natural and synthetic sources while also addressing economic, environmental, and safety issues. An exploratory R&D activity is also in progress to examine new chemistry and catalysts for converting natural gas to higher-valued products. Areas covered are coal gasification, in-situ coal gasification, methane from wastes, coal sciences, and gas separation and chemical processes. Presented are objectives and goals, accomplishments, strategy and basis for each project area, and 1987 status review sheets for projects within the project area.

27543 Thermochemical pretreatment of lignocellulose to enhance methane fermentation. II. Evaluation and application of pretreatment model. Baugh, K.D.; Levy, J.A.; McCarty, P.L. (Kennedy/Jenks/Chilton Consulting Engineers, San Francisco, CA (USA)). *Biotechnology and Bioengineering Symposium;* **31**: No. 1, 62-70(1988).

A model was developed and evaluated as a tool for predicting the formation of soluble products from staged thermochemical treatment of lignocellulosic materials under acidic conditions typical of autohydrolysis. The model was used to predict the general trend of hemicellulose and cellulose hydrolysis between pH 2 and 4 and temperatures of 170-230°C, and results were compared with experimental data. When the model was evaluated for this range of temperatures and pH values, results indicated: 1) a relatively low temperature (175°C) during the first state allows hydrolysis of the hemicellulose polysaccharides without significant monosaccharide decomposition, 2) subsequent stages at higher temperatures (equal or greater than 200°C) are needed for significant cellulose hydrolysis, but glucose decomposition will also occur, and, 3) a pH in the range of 2-2.5 will enhance polysaccharide hydrolysis while limiting monosaccharide decomposition. The model's predictions, indicating that the formation of biodegradable products could be optimized using pretreatments at pH 2-2.5 for the pH range evaluated, were confirmed in experiments with white fir as a representative lignocellulose.

27544 **Thermochemical pretreatment of lignocellulose to enhance methane fermentation. I. Monosaccharide and furfurals hydrothermal decomposition and product formation rates.** Baugh, K.D.; McCarty, P.L. (Kennedy/Jenks/Chilton Consulting Engineers, San Francisco, CA (USA)). *Biotechnology and Bioengineering Symposium;* **31**: No. 1, 50-61(1988).

Over a pH range 1-4 and temperatures from 170 to 230°C, the decomposition rates of xylose, galactose, mannose, glucose, 2-furfural, and 5-hydroxymethyl-2-furfural (5-HMF) were pseudo first order. The effect of temperature and pH on the pseudo first-order decomposition rate constants was modeled using the Arrhenius equation and acid-base catalysis, respectively. Decomposition rates of the monosaccharides were minimum at a pH 2-2.5. Above pH 2.5, the monosaccharide decomposition was base catalyzed, with acid catalysis occurring at a pH of less than 2 for glucose. The furfurals were subject to acid catalysis at below ca. pH 3.5. The hydrothermal conversion of glucose to its decomposition products during thermochemical pretreatment can be modeled as a combination of series and parallel reactions. The formation rates of identified soluble products from glucose decomposition, 5-HMF and levulinic acid, were also functions of temperature and pH. The rate of 5-HMF formation relative to glucose decomposition decreased as the pH increased from 2.0 to 4.0, with levulinic acid formation only detected when the pH was 2.5 or less. For glucose decomposition, humic solids accounted for ca. 20% of the decomposition products.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 28243

27545 **(PB—88-147962/XAB) Combustion and performance characteristics of methanol plus higher alcohols in a spark-ignition engine. Final report.** Patel, K.S. (Illinois Univ., Chicago (USA). Dept. of Mechanical Engineering). Nov 1987. 112p. NTIS, PC A06/MF A01.

A study of the physical and chemical properties and performance of methanol plus higher alcohol (MPHA)-indolene was completed. The fuel properties investigated are distillation characteristics, heat of combustion, flash point, specific gravity, water tolerance, and stoichiometry. The performance parameters investigated are MBT spark advance, knock limited compression ratio, brake power, brake mean effective pressure, brake thermal efficiency and brake specific fuel consumption. The fuel properties of fifteen indolene-alcohol blends were measured at different alcohol concentration in indolene-alcohol blends.

27546 **(PB—88-151873/XAB) Fuel-alcohol production in Honduras: a technical and economic analysis.** Jacobs, A.; Tugwell, F.; Steingass, H.; Alvarez, M.; Arechaga, F. (RONCO Consulting Corp., Arlington, VA (USA)). Apr 1986. 126p. NTIS, PC A07/MF A01.

This study addresses technical issues important to an alcohol initiative in Honduras (Section 2); characteristics of sugar factories as candidates for a distillery (Section 3); financial and economic analyses (Section 4); implementation issues for an alcohol program (Section 5); and an analysis of employment in the cane industry (Section 6). Recommendations concerning alcohol diversification are contained in each section, and are summarized in the Executive Summary. A series of appendices present information on potential dedication of a sugar factory to alcohol, the US alcohol market and trade issues, sugar company profiles, and economic analysis tables.

27547 **(PB—88-159298/XAB) Characteristics of a new methanol synthesis reactor.** Makihara, H.; Kobayashi, K.; Horizoe, H.; Kuwada, C.; Niwa, K. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1987. 8p. NTIS, PC E04/MF A01.

Included in Mitsubishi Heavy Industries Technical Review, Vol. 24, No. 3, 214-219(Oct 1987).

A new type of reactor is presented for the synthesis of methanol in a large-scale plant. It is a simple vertical double-tube heat exchanger, where the catalyst is packed in the annular space, the feed gas is preheated while flowing through inner tubes, and the catalyst bed is cooled from the outside by boiler water and from the inside by feed gas. Consequently, this new type of reactor, in which the reaction proceeds along the maximum reaction-rate trajectory, produces the highest methanol content. The pilot plant shows excellent performance, which is well simulated by numerical analysis utilizing reaction kinetics and a heat transfer model.

27548 **Characterization of Clostridium thermocellum JW20.** Freier, D.; Mothershed, C.P.; Wiegel, J. (Universitaet Goettingen, West Germany). *Applied and Environmental Microbiology;* **54**: No. 1, 204-211(Jan 1988). Contract FG09-84ER13248;FG09-86ER13614.

Clostridium thermocellum JW20 (ATCC 31549), which was isolated from a Louisiana cotton bale, grew on cellulose, cellobiose, and xylooligomers and, after adaptation, on glucose, fructose, and xylose in the pH range of 7.5 to 6.1 with T/sub opt/ of 60°C, T/sub max/ of 69°C, and T/sub min/ of above 28°C. Doubling times during growth on cellulose and cellobiose were 6.5 and 2.6 h, respectively. The G+C content of the DNA was 40 mol% (chemical analysis). Growth on cellulose as substrate was totally inhibited in the presence of more than 125 mM sodium sulfate, 300 mM sodium chloride, 250 mM potassium chloride, 200 mM calcium chloride, 125 mM magnesium chloride, 40 mM lactate, or 250 mM acetate. The ratio of the fermentation products ethanol to acetate plus H_2 decreased when the culture was agitated. Agitation otherwise increased the rate of cellulose degradation in a growing culture but not under nongrowth conditions or with cell-free culture supernatant containing the extracellular cellulase. Shaking lowered the concentration of H_2 in the culture broth and thus minimized inhibition by the H_2 formed. Externally added H_2 caused an increased formation of ethanol during growth on cellulose or cellobiose. However, at an atmospheric pressure as high as 355 kPa (50 lb/in^2), H_2 did not cause significant growth inhibition beyond an increasing lag phase (up to 24 h). Several criteria to specifically prove the purity of C. thermocellum cultures were suggested.

27549 **Macromolecular organization of the cellulolytic enzyme complex of Clostridium thermocellum as revealed by electron microscopy.** Mayer, F.; Coughlan, M.P.; Mori, Y.; Ljungdahl, L.G. (Univ. of Goettingen, West Germany). *Applied and Environmental Microbiology;* **53**: No. 12, 2785-2792(Dec 1987). Contract AS09-79ER10499.

Clostridium thermocellum JW20 and YM4 both synthesize cellulolytic enzyme complexes, cellulosomes, when grown on medium containing cellulose. In the early stages of cultivation, the cellulosomes from both species exist as tightly packed complexes (tight cellulosomes). These subsequently decompose to loosely packed complexes (loose cellulosomes) and ultimately to free polypeptides. Examination of the loose cellulosomal particles showed that the contain rows of equidistantly spaced, similarly sized polypeptide subunits, with an apparently identical orientation arranged parallel to the major axis of the cellulosome. It is postulated that on binding of a cellulose chain alongside such a row of subunits a simultaneous multicutting event occurs that leads to the release of cellooligosaccharides of four cellobiose units in length (C_4). Rows of smaller-sized subunits with lower center-to-center distances, which are also present in the cellulosome, subsequently cleave the C_4 fragments (or cellulose) to C_2 (cellotetraose) or C_1 (cellobiose).

In this way the cellulosome can catalyze the complete hydrolysis of cellulose.

27550 **Characteristics of immobilized yeast reactor producing ethanol from glucose.** Anselme, M.J.; Tedder, D.W. (Georgia Institute of Technology, Atlanta (USA)). *Biotechnology and Bioengineering Symposium;* 30: No. 6, 736-745(Oct 1987).

The evolutionary performance of upflow reactors are affected by the cell immobilization matrix and the matrix particle size distribution. Higher productivities are obtained using a low-density brick with a particle size of ca. 400-1400 μm. A medium condition favoring growth quickly leads to large biomass gradients within the reactors and, eventually, reduction in average productivities due to bed plugging. These systems can be accurately modeled using Monod kinetics when dispersion and the biomass gradient are considered. The productivity was apparently not controlled by substrate diffusion in these cases.

27551 **Ethanol from lignocellulose - An overview.** Wright, J.D. New York, NY; American Institute of Chemical Engineers (1987). 18p. (CONF-870822—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

Technical Paper 24A.

Ethanol, a liquid fuel compatible with today's transportation system, can be produced by biological processes from lingocellulosic feedstocks. Biomass is an attractive feedstock for ethanol production because it is available in large quantities at low cost. Biological processes are very efficient, but each fraction of the lignocellulosic feedstock must be processed separately. Cellulose (a crystalline polymer of glucose), the structural core, comprises 40% of the feedstock. It is difficult to hydrolyze (break down) into glucose, but once formed, the glucose is readily fermented to ethanol. Cellulose can be hydrolyzed with either acid or enzymatic catalysts. Using acids, the chief problem is that conditions severe enough to promote hydrolysis also degrade the glucose, resulting in low (55%-80%) yields. Enzymatic processes are potentially much more efficient because enzymes catalyze only the hydrolysis reaction. However, these processes are much newer and less developed. Research is required to develop methods to make lignocellulose more digestible, to produce more active enzymes at lower cost, and to develop methods of hydrolysis where enzyme action is not inhibited by reaction end products. Approximately 30% of the feedstock is hemicellulose, which is largely made of xylan (a polymer of xylose). Xylan is easily hydrolyzed, but it is difficult to ferment to ethanol. Several potential methods of fermentation have been identified, but it is not yet clear which is the most promising. Lignin, the final major component, is a phenolic polymer that cannot be fermented to ethanol. However, it can be broken down to phenolic monomers, hydrotreated, and reacted with methanol to produce methyl aryl ethers, a high-octane gasoline additive.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 28125

13 Power-conversion Systems

REFER ALSO TO CITATION(S) 27577

14 SOLAR ENERGY

1401 Resources And Availability

27552 **(AD-A—188414/7/XAB) Estimating the solar irradiance of an intermountain region using GOES (Geostationary Operational Environmental Satellite) satellite data: a test of two statistical models. Master's thesis.** Walters, M.S. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1987. 154p. (AFIT/CI/NR—87-112T). NTIS, PC A08/MF A01.

The performance of two statistical models that use satellite data to calculate the global solar radiation incident upon the earth's surface are assessed. The estimates are determined for a mid latitude ten station network and represent a variety of sky cover conditions. Evaluations of the models for different sky conditions reveal the need for revised regression coefficients for the Hay and Hanson (1978) model and the Tarpley (1979) model. The Hay and Hanson (1978) model was shown to perform better for partly cloudy and overcast sky conditions while the Tarpley (1979) model performed better under clear skies. On an hourly and daily time scale, the Hay and Hanson (1978) model proved to be the better performer.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 28236

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 27543, 27544, 27548, 27549, 27550, 28236

27553 **(PB—88-161096/XAB) Illustrating harvest effects on site microclimate in a high-elevation forest stand. Forest Service research note.** Fowler, W.B.; Anderson, T.D. (Forest Service, Portland, OR (USA). Pacific Northwest Research Station). Aug 1987. 13p. (FSRN-PNW—466). NTIS, PC A03/MF A01.

Three-dimensional contour surfaces were drawn for physiologically active radiation (PAR) and air and soil temperatures from measurements taken at a high-elevation site (145 m) near the crest of the Cascade Range in central Washington. Measurements in a clearcut were compared with measurements from an adjacent uncut stand. Data for 31 days in July and August 1985 illustrated the rapid changes as storms off the Pacific Ocean displaced the dominant high pressure of summer.

27554 **(PB—88-178561/XAB) Biogasification of woody biomass. Annual report, March 1986-February 1987.** Chynoweth, D.P.; Jerger, D.E.; Earle, J.F.K.; Brown, R.D.; Yang, J.C. (Florida Univ., Gainesville (USA)). Apr 1987. 78p. NTIS, PC A05/MF A01.

See also Final rept. for July 1982-April 1983, PB—84-237775.

The objectives of the research are to characterize the principal bacteria, interactions, and factors limiting depolymerization yields and rates during the methane fermentation of woody biomass and to develop and evaluate an efficient biological process for conversion of woody biomass to methane and other resources. Several samples of poplar woodgrass from Northwest Missouri State University (NWMSU) and willow from State University of New York (SUNY) were obtained and analyzed for chemical composition and biochemical methane potential (BMP). Both samples exhibited methane yields of about 4.0 SCF/lb VS added which is lower than that observed from previous poplar samples. Experiments were completed to determine the effects of pH on the biogasification of cellulose, the major component of woody biomass. Conversion of cellulose to methane and carbon dioxide was inhibited at pH's of 5 and 8; while a lag phase was observed in the batch reactors maintained at pH 6. Greater than 90% conversion of the cellulose to fermentation products was completed within 4-6 days in reactors at pH 7. A 10-L mesophilic woodgrass continuous-stirred tank reactor (CSTR) was operated at 0.15 lb VS/cu. ft.-day loading, a 50-day hydraulic retention time (HRT), and a 12% feed solids concentration to serve as a baseline system for microbiology and enzymology studies. Anaerobic dilution series were conducted on samples collected from the EMP assays and mesophilic CSTR digester using a medium routinely used for methanogenic bacteria modified by addition of cellulose or pulverized poplar. Numbers from the CSTR exceeded 10^9/mL indicating that the medium was suitable. Two cellulolytic organisms were isolated at high dilution and characterized from woodgrass digesters: one from the BMP reactor, the other from the CSTR.

27555 **(PB—88-902000/XAB) Government Research and Development Summaries: Solar Project Briefs. Monthly report.** (CSR, Inc., Washington, DC (USA). Power Information Center). 1988. ap. NTIS Subscription.

Supersedes PB—87-902000; Paper copy available on subscription $80.00/year. U.S. sales only, excluding embassies. Additional subject categories available at a discount. Also available in single copies.

Solar Project Briefs describe the status of all R&D programs submitted to the Power Information Center by the government sponsors in solar-radiation collection, storage, and conversion to heat or other energy forms. Photovoltaic and solar thermal devices and related systems are also reported. The document is not to be reproduced, in whole or in part, for dissemination outside your own organization nor may it be reproduced for advertising or sales promotion purposes.

27556 **Fabrication of diode arrays for photovoltaic characterization of silicon substrates.** Sopori, B.L. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401). *Applied Physics Letters;* **52**: No. 20, 1718-1720(16 May 1988).

A simple process sequence for the fabrication of passivated mesa diode arrays for photovoltaic characterization of single/polycrystalline silicon substrates is described. These diodes are used to measure a variety of substrate and cell parameters including resistivity, minority-carrier diffusion length, V/sub oc/, J/sub sc/, fill factor, and current-voltage characteristics for analysis of the electronic transport properties. Evaluation techniques which use these diodes for determining spatial variations in the material/device charateristics are described. These devices are also suitable for characterizing various cell fabrication processes and for analysis of crystal defects on the solar cell characteristics.

27557 **Compensating impurities as the limiting factor in atmospheric pressure chemical vapor deposition of a-Si:H from Mg_2Si generated higher silanes.** McCurdy, R.J.; Gordon, R.G. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). *Journal of Applied Physics;* **63**: No. 9, 4669-4676(1 May 1988).

The limiting factor for the lack of reproducibility in previous studies of atmospheric pressure chemical vapor deposition of a-Si:H from Mg_2Si generated higher silanes is contamination by gas phase dopant impurities, both n and p type originating from the higher silanes production system. An n-type impurity is shown to originate from the drying column. After elimination of this impurity, the a-Si:H films produced showed evidence of p-type doping. Secondary ion mass spectroscopy analyses of the resulting films identify boron as the p-type dopant. The incorporation of boron into the films was varied by preheating the reactant gas immediately prior to deposition. The ideal preheat temperature is shown to be between 350 and 400 °C. Films deposited with a preheat of 375 °C showed no flow dependence of the hole diffusion length and the best electron transport properties. Attempts at removing the boron impurity from the gas stream were also made. A Porapak Q/sup X/ column installed at the end of the drying column was found to be reasonably effective. Depositions of a-Si:H were also made utilizing a commercially purified tank of Si_2H_6. The lack of evidence of compensating or p-type doping in this system firmly establishes the impurities as originating from the Mg_2Si based silanes production system.

27558 **Construction of an Escherichia coli-rhodococcus shuttle vector and plasmid transformation in Rhodococcus spp.** Singer, M.E.V.; Finnerty, W.R. (Univ. of Georgia, Athens). *Journal of Bacteriology;* **170**: No. 2, 638-645(Feb 1988). Contract FG09-86ER13588.

A plasmid transformation system for Rhodococcus sp. strain H13-A was developed by using an Escherichia coli-Rhodococcus shuttle plasmid constructed in this study. Rhodococcus sp. strain H13-A contains three cryptic indigenous plasmids, designated pMVS100, pMVS200, and pMVS300, of 75, 19.5, and 13.4 kilobases (kb), respectively. A 3.8-kb restriction fragment of pMVS300 was cloned into pIJ30, a 6.3-kb pBR322 derivative, containing the E. coli origin of replication (ori) and ampicillin resistance determinant (bla), as well as a Streptomyces gene for thiostrepton resistance, tsr. The resulting 10.1-kb recombinant plasmid, designated pMVS301, was isolated from E. coli DH1 (pMVS301) and transformed into Rhodococccus sp. strain AS-50, a derivative of strain H13-A. The cloned 3.8-kb fragment of Rhodococcus DNA in pMVS301 contains a Rhodococcus origin of replication, since the hybrid plasmid was capable of replication in both genera. The plasmid was identical in E. coli and Rhodococcus transformants as determined by restriction analysis and was maintained as a stable, independent replicon in both organisms. A restriction map demonstrated 14 unique restriction sites in pMVS301, some of which are potentially useful for molecular cloning in Rhodococcus spp. and other actinomycetes. This is the first report of plasmid transformation and of heterologous gene expression in a Rhodococcus sp.

27559 **Isolation of auxotrophic mutants of Methylophilus methylotrophus by modified-marked exchange.** Bohanon, M.J.; Bastien, C.A.; Yoshida, R.; Hanson, R.S. (Univ. of Minnesota, Navarre). *Applied and Environmental Microbiology;* **54**: No. 1, 271-273(Jan 1988).

A method of stabilizing a transposon (Tn5) has been developed which allows the isolation of stable auxotrophic mutants of Methylophilus methylotrophus AS1. Insertion of Tn5 into a cloned M. metylotrophus AS1 DNA fragment encoding anthranilate synthase followed by transfer of the vector with the modified trpE gene to M. methylotrophus AS1 resulted in unstable auxotrophs among the recombinants. Deletion of IS50R, which encodes transposase production from Tn5, stabilized the transposon after mobilization to M. methylotrophus AS1. When trpE genes with the modified Tn5 inserts were mobilized into M. methylotrophus AS1, stable, kanamycin-resistant tryptophan auxotrophs were obtained by double-crossover homologous recombination with the chromosome.

27560 **Antenna organization in green photosynthetic bacteria. 1. Oligomeric bacteriochlorophyll c as a model for the 740 nm absorbing bacteriochlorophyll c in Chloroflexus aurantiacus chlorosomes.** Brune, D.C.; Nozawa, T.; Blankenship, R.E. (Arizona State Univ., Tempe (USA)). *Biochemistry;* **26**: No. 26, 8644-8652(29 Dec 1987).

Bacteriochlorophyll (BChl) c was extracted from Chloroflexus aurantiacus and purified by reverse-phase high-pressure liquid chromatography. This pigment consists of a complex mixture of homologues, the major component of which is 4-ethyl-5-methylbacteriochlorophyll c stearyl ester. Unlike previously characterized BChls c, the pigment from C. aurantiacus is a racemic mixture of diastereoisomers with different configurations at the 2a chiral center. Diluting a concentrated methylene chloride solution of BChl c with hexane produces an oligomer with absorption maxima at 740-742 and at 460-462 nm. Both the absorption spectrum and the fluorescence emission spectrum (maximum at 750 nm) of this oligomer closely match those of BChl c in chlorosomes. Further support for this model comes from the ability of alcohols, which disrupt BChl c oligomers by ligating the central Mg atom, to convert BChl c in chlorosomes to a monomeric form when added in low concentrations. The lifetime of fluorescence from the 740 nm absorbing BChl c oligomer is about 80 ps. Although exciton quenching might be unusually fast in the in vitro BChl c oligomer because of its large size and/or the presence of minor impurities, this result suggests that energy transfer from the BChl c antenna in chlorosomes must be very fast if it is to be efficient.

27561 **Antenna organization in green photosynthetic bacteria. 2. Excitation transfer in detached and membrane-bound chlorosomes from Chloroflexus aurantiacus.** Brune, D.C.; King, G.H.; Infosino, A.; Steiner, T.; Thewalt, M.L.W.; Blankenship, R.E. (Arizona State Univ., Tempe (USA)). *Biochemistry;* **26**: No. 26, 8652-8658(29 Dec 1987).

The photosynthetic antenna of Chloroflexus aurantiacus includes bacteriochlorophyll (BChl) c_{740} and BChl a_{802}, both of which occur in chlorosomes, and B808-866 (containing BChl a_{808} and BChl a_{866}), which is membrane-located (subscripts refer to near-infrared absorption maxima in vivo). BChl a_{792} is thought to mediate excitation transfer from BChl c_{740} to BChl a_{808}. Lifetimes of fluorescence from BChl c_{792} and BChl a_{792} were measured in isolated and membrane-bound chlorosomes in order to study energy transfer from these pigments. In both preparations, the lifetime of BChl c_{740} fluorescence was at or below the instrumental limit of

temporal resolution (about 30-50 ps), implying extremely fast excitation transfer from this pigment. Attempts to disrupt excitation transfer from BChl c_{740}, either by conversion of part of this pigment to a monomeric form absorbing at 671 nm or by partial destruction of BChl a_{792} by oxidation with $K_3Fe(CN)_6$, had no discernible effects on the lifetime of BChl c_{740} fluorescence. Most of the fluorescence from BChl a_{792} decayed with a lifetime of 93 +/- 21 ps in membrane-attached chlorosomes and 155 +/- 22 ps in isolated chlorosomes at room temperature. Assuming that the only difference between these preparations is the occurrence of excitation transfer from BChl a_{792} to B808-866, a 41% efficiency was calculated for this process. These results imply either that BChl a_{792} is not an obligatory intermediate in energy transfer from BChl $c_7$$_0$ to B808-866 or (more probably) that chlorosome isolation introduces new processes for quenching fluorescence from BChl a_{792}.

27562 **Extracellular enzyme activities during lignocellulose degradation by Streptomyces spp.: a comparative study of wild-type and genetically manipulated strains.** Ramachandra, M.; Crawford, D.L.; Pometto, A.L. III. (Univ. of Idaho, Moscow). *Applied and Environmental Microbiology;* 53: No. 12, 2754-2760(Dec 1987).

The wild-type ligninolytic actinomycete Streptomyces viridosporus T7A and two genetically manipulated strains with enhanced abilities to produce a water-soluble lignin degradation intermediate, an acid-precipitable polymeric lignin (APPL), were grown on lignocellulose in solid-state fermentation cultures. Culture filtrates were periodically collected, analyzed for APPL, and assayed for extracellular lignocellulose-catabolizing enzyme activities. Two APPL-overproducing strains, UV irradiation mutant T7A-81 and protoplast fusion recombinant SR-10, had higher and longer persisting peroxidase, esterase, and endoglucanase activities than did the wild-type strain T7A. Results implicated one or more of these enzymes in lignin solubilization. Only mutant T7A-81 had higher xylanase activity than the wild type. The peroxidase was induced by both lignocellulose and APPL. This extracellular enzyme has some similarities to previously described ligninases in fungi. This is the first report of such an enzyme in Streptomyces spp. Four peroxidase isozymes were present, and all catalyzed the oxidation of 3,4-dihydroxyphenylalanine, while one also catalyzed hydrogen peroxide-dependent oxidation of homoprotocatechuic acid and caffeic acid. Three constitutive esterase isozymes were produced which differed in substrate specificity toward α-naphthyl acetate and α-naphthyl butyrate. Three endoglucanase bands, which also exhibited a low level of xylanase activity, were identified on polyacrylamide gels as was one xylanase-specific band. There were no major differences in the isoenzymes produced by the different strains. The probable role of each enzyme in lignocellulose degradation is discussed.

27563 **Clostridium acetobutylicum mutants that produce butyraldehyde and altered quantities of solvents.** Rogers, P.; Palosaari, N. (Univ. of Minnesota, MN). *Applied and Environmental Microbiology;* 53: No. 12, 2761-2766(Dec 1987).

Spontaneous mutants of Clostridium acetobutylicum NRRL B643 that were resistant to allyl alcohol (AA) were selected and characterized. These mutants contained 10- to 100-fold reduced activities of butanol and ethanol alcohol dehydrogenase. The AA mutants formed two groups and produced no ethanol. Type 1 AA mutants produced significant amounts of a new solvent, butyraldehyde, and contained normal levels of the coenzyme A-dependent butyraldehyde dehydrogenase (BAD). Type 2 AA mutants produced no significant butyraldehyde and lower levels of all solvents, and they contained 45- to 100-fold lower activity levels of BAD. Following ethyl methanesulfonate mutagenesis, low-acid-producing ($Acid^-$) mutants were selected and characterized as superinduced solvent producers, yielding more than 99% of theoretical glucose carbon as solvents and only small amounts of acetate and butyrate. Following ethyl methanesulfonate mutagenesis, 13 sporulation-negative (Spo^-) mutants were characterized; and 3 were found to produce only butyrate and acetate, a minor amount of acetone, and no alcohols. These Spo^- mutants contained reduced butanol dehydrogenase activity and no BAD enzyme activity. The data support the view that the type 2 AA, the $Acid^-$, and the Spo^- mutants somehow alter normal regulated expression of the solvent pathway in C. acetobutylicum.

27564 **Potential enhancement of photosynthetic energy conversion in algal mass culture.** Sukenik, A.; Falkowski, P.G.;Bennett, J. (Brookhaven National Lab., Upton, NY (USA)). *Biotechnology and Bioengineering Symposium;* 30: No. 8, 970-977(Dec 1987). Contract AC02-76CH00016.

Actual laboratory data obtained from steady-state Dunaliella tertiolecta cultures grown under a wide range of photon flux densities were used in a simple model to calculate daily production in a conventional algal mass culture system. In spite of large physiological and biochemical variations between low-light (LL) and high-light (HL) adapted cultures, the overall calculated daily productivity is almost identical for both strains grown at optimal conditions. When production of fine biochemicals is considered, however, a hypothetical HL strain, which cannot shade adapt, is advantageous. Based on biochemical and biophysical analysis of D. tertiolectra responses to growth irradiance levels, specific targets are defined for genetic manipulation to enhance productivity in algal mass culture systems. The targets identified are (1) amplification of the carboxylation enzyme ribulose-1,5-bisphosphate carboxylase-oxygenase relative to the electron transport complexes, which should increase photosynthetic capacity at light saturation, and (2) enlargement of the light-harvesting complexes by varying their pigment composition in order to increase light harvesting at low photon flux densities.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 27635

27565 **(PB—88-157193/XAB) Lyckebo Project, solar district heating with seasonal storage in a rock cavern: evaluation and operational experience.** Brunstroem, C.; Hillstroem, C.G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 35p. (D—20:1987). NTIS, PC E03/MF A01.

The Lyckebo solar district-heating system represents a major technical and economic step forward in the development of solar-heating systems incorporating seasonal heat stores. The plant was built with the objective of developing, demonstrating, and evaluating a large-scale 100% solar-heat-based district-heating system in combination with a hot-water heat store in an open (= unpressurized) rock cavern. The first stage of the research and assessment work was concluded in July 1986, and this report summarizes the most-important results and experience from the project up to that date.

27566 **(PB—88-168885/XAB) Solar water heating.** (Middle East Center for the Transfer of Appropriate Technology, Beirut (Lebanon)). 1985. 21p. (In Arabic). NTIS, PC A03.

The booklet explains the principles of, and explains with diagrams how to build a solar hot water heater.

27567 **(PB—88-168893/XAB) Solar cooking.** (Middle East Center for the Transfer of Appropriate Technology, Beirut (Lebanon)). 1985. 21p. (In Arabic). NTIS, PC A03.

The booklet explains the principles of, and explains with diagrams how to build several different types of solar cookers.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

27568 **(PB—88-164280/XAB) Analysis of historical and current drawdown and production data from the Boise geothermal system. Research technical completion report.** Waag, C.J.; Wood, S.H. (Boise State Univ., ID (USA). Dept. of Geology and Geophysics). Aug 1987. 58p. NTIS, PC A04/MF A01.

Since 1982 withdrawals from the Boise Geothermal aquifer system have increased from less than 300 million to over 600 million gals/yr. Prior to 1983 the system appears to have been in or near equilibrium. Current production levels exceed the ability of

the system to recover on an annual basis. Potentiometric levels within the aquifer are declining at increasing rates and a new equilibrium level is not evident. Thus, exploitation of the geothermal aquifer is currently outstripping knowledge and understanding of the aquifer. It is time to give serious consideration to placing a temporary moratorium on further development and production from the system until a better understanding of its capacity is achieved.

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 27666

1509 Geothermal Engineering

27569 (CONF-8704110—, pp 189-194) **Brine simulation models for geothermal plant operations.** Weare, J.H.; Moeller, N. (Univ. of California, San Diego, La Jolla). 1987. NTIS, PC A11/MF A01. Order Number DE88003737/JAW. Contract AC03-85SF15522.

From 5. geothermal program review; Washington, DC, USA (14 Apr 1987).

A computer simulation model is being developed which will predict the chemical behavior of geothermal brines for a wide range of operating conditions. The program will be utilized by the geothermal community to predict and avoid common problems such as mineral scale formation and injected brine incompatibilities. The current phase of the program emphasizes parameterization of a variable temperature precipitation model for the scale-forming minerals, calcite ($CaCO_3$) and anhydrite ($CaSO_4$). The technology developed to date as part of this program has useful applications in many fields. Consequently, this technology is being transferred to other industries and government agencies.

17 WIND ENERGY

1701 Availability (climatology)

27570 **(PB—88-164827/XAB) Development of a methodology to evaluate the wind potential in tropical regions. Phase 1. No. 3. Travel report, Khartoum (Sudan), October 12-November 26, (1985).** Bakr, E.H.A. (Technische Hogeschool Eindhoven (Netherlands). Wind Energy Group). Feb 1986. 42p. (R—768-D). NTIS, PC E03/MF A01.

The research program on a methodology to evaluate the wind potential in tropical regions where the Khartoum region in Sudan is taken as a test case, consists of two phases: Phase I - evaluating the existing wind speed and other data in the Sudan, and in particular in the Khartoum area, to set up for the latter a homogeneous data base (wind speed, etc.) which is used for the investigation in phase II; phase II - setting up a physical model of the boundary layer using boundary-layer equations adapted to tropical conditions, to be able to estimate the wind potential in tropical regions on the basis of surface- and upper-air data. The Khartoum data serve as a reference to check the validity of the model. The report gives an insight into all the meteorological stations in the Khartoum region and their surroundings. The type of stations and the data collection are discussed in chapter II and III. The characteristics of the stations' surroundings are represented. The set of the data obtained is tabulated.

27571 **(PB—88-164835/XAB) Development of a methodology to evaluate the wind potential in tropical regions. Phase 1, No. 2. Travel report Bracknell (UK), August 19-September 2, 1985.** Bakr, E.H.A. (Technische Hogeschool Eindhoven (Netherlands). Wind Energy Group). Sep 1985. 16p. (R—767-D). NTIS, PC E03/MF A01.

The report concerns a visit to the meteorological office in Bracknell, England to develop a methodology to evaluate the wind potential in tropical regions. The objectives of the visit were: to collect all available information about the meteorological stations in Sudan; to obtain for the last 5 years the daily wind data obtained from Sudan which are used in Bracknell for plotting the world meteorological charts.

1704 Economics

27572 **(PB—88-165824/XAB) Benchmark test of power-curve computations. Final report on the CWD (Consultancy Services Wind Energy Developing Countries) contribution.** Cleyne, H.; Helden, W.; Meel, J.; Kragten, A.; Kuik, G. (Technische Hogeschool Eindhoven (Netherlands). Wind Energy Group). Dec 1986. 102p. (R—833-D). NTIS, PC E05/MF A01.

At the meeting of test stations for wind turbines in Lannion, France, in May 1984, proposals were discused for a series of projects to be carried out with cooperation among the test stations. The report concerns one of these projects. Consulting services Wind Energy Developing Countries (CWD) will concentrate especially on multiblade rotors, which are typical for water-pumping windmills. For the project as a whole, slow-running rotors are of specific interest, since the difficulties in computational models can be expected to become evident most clearly for slow-running rotors.

1706 Wind Energy Engineering

27573 **(PB—88-164678/XAB) BWEA meeting on small wind-powered systems, May 7, 1986.** Smulders, P.T. (Technische Hogeschool Eindhoven (Netherlands). Wind Energy Group). Jun 1986. 22p. (R—791-D). NTIS, PC E03/MF A01.

The following papers were presented at the meeting: Performance monitoring of wind pumps in Kenya; Wind-generator-powered water pumping; Small wind pumps - systems assessment; IEA recommendations useless for windmill-driven piston pumps; Review of power-transmission options for wind powered water pumping; Operational experience with hybrid wind/diesel systems; The Aerowatt international wind/diesel hybrid grid; Controls for small wind/PV/battery systems; The development of an aerogenerator and its application in a small-scale hybrid system: Part 1, the aerogenerator; The development of an aerogenerator and its application in a small-scale hybrid system: Part 2, the hybrid system; Wind-based natural energy for telecommunications system.

27574 **(PB—88-164686/XAB) Benchmark test of power-curve computations specification of three multiblade rotors.** Meel, J.; van Kuik, G. (Technische Hogeschool Eindhoven (Netherlands). Wind Energy Group). Jun 1986. 33p. (R—793-D). NTIS, PC E03/MF A01.

This report concerns the project: 'Benchmark test of power-curve computations'. The report concerns the specification of three multiblade rotors. For the rotors defined, wind-tunnel measurements were performed. Results of the measurements were to be available when participants in the project presented results of their computations. Besides the rotor specifications, the report contains relevant profile characteristics.

27575 **(PB—88-164819/XAB) Wind energy for water pumping in developing countries.** Smulders, P.T. (Technische Hogeschool Eindhoven (Netherlands). Wind Energy Group). Oct 1986. 11p. (R—817-D). NTIS, PC E03/MF A01.

The technological development of water pumpers is still in its beginning; considerable reduction in water costs can still be achieved. The economic competitiveness of wind pumps to other pumping options depends on many many factors, that need to be carefully analyzed before embarking on a dissemination program. The introduction and dissemination of a new technology is a very complex process; it will take many years for dissemination processes to become self-supporting. Training is a vital aspect in any project. To avoid expensive learning by trial and error in faraway places, an extension of field testing at laboratory field sites is imperative.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 27415, 27431

27576 (PB—88-151246/XAB) IHI (Ishikawajima-Harima Heavy Industries) Engineering Review, Vol. 20, No. 4, Serial No. 64, October 1987. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1987. 50p. NTIS, PC E03/MF A01.

See also PB—87-219838.

Contents include: NOx and unburned-carbon simulation technologies on pulverized coal-firing boiler - 2nd report evaluation of NOx formation and NOx control technology for foreign coals; development and applications of CAD system for industrial turbomachinery - mechanical designing; seawater pretreatment by continuous sand filter for seawater RO (reverse osmosis) desalination plant; coal-handling management and control system for bulk terminal; 56-MW barge-mounted gas-turbine power plant for Bangladesh Power Development Board (Bangladesh); large-type ion-plating equipment for Taiyo Seisakusho; automatic warehouse for apple storage in CA condition for Yamadai Co., Ltd.; absolute-type optical-fiber rotary encoder for National Aerospace Laboratory Science and Technology Agency; Sea-Master Mark-II system; high-density plasma-producing device delivered to Isas of Ministry of Education; storage and transfer system delivered to Kawamura Electric Co.; 500-MW coal fired steam generator delivered to Shin-Onoda Thermal Power Station No. 2, unit of Chugoku Electric Power Co.

27577 (PB—88-151279/XAB) Fuji Electric Review, Vol. 33, No. 3, 1987. (Fuji Electric Co. Ltd., Tokyo (Japan)). 1987. 53p. NTIS, PC E04/MF A01.

See also Volume 33, Number 2, PB—88-130380.

Contents include: advanced technology of steam turbines; advanced technology of turbine generators; recent control system for thermal power plant; recent techniques of water turbine; progress of hydraulic turbine generator; recent control and protection techniques for hydraulic power plant; large bulb turbine and generator (for New Martinsville hydroelectric project).

27578 (PB—88-166459/XAB) BDRCOMP - a program for the comparison of BDR (Boiler Dynamics Rig) data with NUMEL predictions. McCabe, E.M. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). 1987. 56p. (TPRD/M—1642/RR87). NTIS, PC E05/MF E05.

A series of well-defined benchmark tests are being carried out on the Boiler Dynamics Rig (BDR) at MEL. These tests form part of the on-going task to provide Quality Assurance for the NUMEL code, the United Kingdom (UK) reference monotube dynamic boiler model. To facilitate the handling of fluctuations in the experimentally measured boundary conditions, as input data, and to account for all the program requirements, the BDRCOMP program was developed. This report describes the BDRCOMP code and the options available for processing rig measurements and presenting the comparisons of model and rig results. The report is one of a series that constitute the Quality Assurance Document: NUMEL Validation Against Benchmark Tests on the Boiler Dynamics Rig. It relates specifically to Part 1 (Boiler Dynamics Rig Description and Methodology), where the NUMEL comparisons are introduced, and Part 2 (Single Channel Transients), where full details of the first series of benchmark tests are given. Other QA documents should be consulted for information on the rig instrumentation, the actual tests performed and any further details.

27579 (PB—88-177977/XAB) Report to Congress: wastes from the combustion of coal by electric-utility power plants. Final report. (ICF, Inc., Fairfax, VA (USA)). Feb 1988. 374p. NTIS, PC A16/MF A01.

See also Appendices, PB—88-177985.

Under Section 8002(N) of RCRA, the Report to Congress is to address: source and volumes of wastes generated per year; present disposal and utilization practices; potential danger to human health and the environment; documented cases in which danger to human health or the environment has been proved; alternatives to current disposal methods; cost of alternative disposal methods; impact of alternatives on the use of coal and other natural resources; current and potential utilization of waste materials.

27580 (PB—88-177985/XAB) Report to Congress: wastes from the combustion of coal by electric utility power plants. Appendices. (ICF, Inc., Fairfax, VA (USA)). Feb 1988. 176p. NTIS, PC A09/MF A01.

See also Final rept., PB—88-177977.

Under Section 8002(N) of RCRA, the Report to Congress is to address: source and volumes of wastes generated per year; present disposal and utilization practices; potential danger to human health and the environment; documented cases in which danger to human health or the environment has been proved; alternatives to current disposal methods; cost of alternative disposal methods; impact of alternatives on the use of coal and other natural resources; and current and potential utilization of waste materials.

27581 (PB—88-178603/XAB) Engineering feasibility study of new gas technologies for waste-to-energy boilers to improve operational and environmental characteristics. Topical report, September 1986-February 1987. Lange, H.B.; Bell, A.W.; Blakeslee, C.E.; Pohl, J.H. (Energy Systems Associates, Tustin, CA (USA)). Sep 1987. 176p. (ESA—18900-358). NTIS, PC A09/MF A01.

New gas technologies to improve the operational and environmental characteristics of waste-to-energy boilers were evaluated. The study indicated that further reductions of PIC emissions from these boilers, which are an important public-health concern, may be achievable through improved control of the combustion process in the furnace. A conceptual design of a distributed-burner system and more-sophisticated combustion controls, expressly designed for PIC reduction, is presented. Also presented is a conceptual design of an ash afterburner system intended to detoxify the fly-ash waste stream, where PIC tend to concentrate.

27582 (PB—88-860333/XAB) Boiler and steam-generator corrosion. January 1970-March 1988 (Citations from the NTIS data base). Report for January 1970-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 183p. NTIS PC N01/MF N01.

Supersedes PB—86-870979.

This bibliography contains citations concerning corrosion effects, mechanisms, detection, and inhibition in fossil-fuel-fired boilers and nuclear powered steam generators. Corrosion studies performed on the water side and hot gas side of heat-exchanger tubes and support structures are presented. Water treatment, chemical cleaning, and descaling methods are considered. Although emphasis is placed on large-scale power generation systems, residential and commercial heating systems are also discussed. (This updated bibliography contains 366 citations, 24 of which are new entries to the previous edition.)

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 27576, 27897, 27898, 28113, 28114, 28118, 28124, 28169, 28175

27583 (PB—88-161823/XAB) Determination of gas-phase dimethyl sulfate and monomethyl hydrogen sulfate. Hansen, L.D.; White, V.F.; Eatough, D.J. (Brigham Young Univ., Provo, UT (USA). Thermochemical Inst.). 1986. 9p. (CONTRIB—362). NTIS, PC A02/MF A01.

Pub. in Environ. Sci. Technol., Vol. 20, No. 9, 872-878(Sep 1986).

Analytical techniques were developed for the collection and determination of gas-phase dimethyl sulfate and monomethyl sulfuric acid in the flue lines and plumes of power plants and in the ambient atmosphere. The techniques involve the collection of the gas phase species in denuders which are selective for monomethyl sulfuric acid or which collect both dimethyl sulfate and monomethyl sulfuric acid, and determination of the deposition pattern of the collected alkyl sulfates in the denuder. In addition, both dimethyl sul-

fate and monomethyl sulfuric acid are collected in filter pack, sorbent-bed combinations which allow for the separate determination of both dimethyl sulfate and monomethyl sulfuric acid or for their joint collection and determination. Monomethyl sulfuric acid is determined by ion chromatography. Dimethyl sulfate is determined either by ion chromatography or by gas chromatography, depending on the collection device used.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 28770

27584 **(PB—88-165519/XAB) Asymptotics for a system of nonlinearly coupled wave equations with an application to the galloping oscillations of overhead transmission lines.** van Horssen, W.T. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1987. 44p. (REPT—87-78). NTIS, PC E03/MF A01.

An asymptotic theory for a class of initial-boundary-value problems for systems of weakly, nonlinearly coupled wave equations is presented. The theory implies the well-posedness of the problem in the classical sense and the validity of formal approximations on long time scales. As an application of the theory, an initial-boundary-value problem for a system of weakly, nonlinearly coupled wave equations is studied in detail, using a two-timescale perturbation method. From an aero-elastic analysis, it is shown that this initial-boundary-value problem may be regarded as a model describing the galloping oscillations of overhead transmission lines in the vertical and in the horizontal direction.

27585 **(PB—88-859533/XAB) Superconducting cables: long-distance energy transmission. January 1973-February 1988 (Citations from the NTIS data base). Report for January 1973-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 62p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the design, development, and evaluation of superconducting cables and power-transmission lines for long-distance energy transmission. Topics include methods of cryogenic refrigeration and electrical insulation, fabrication and development of niobium-alloy conductors, energy-loss analysis, and dielectric-design techniques for superconducting power-transmission systems. Government research project reports on superconducting technology for electric-power transmission and distribution are included. (Contains 129 citations fully indexed and including a title list.)

21 NUCLEAR POWER PLANTS

27586 **(INIS-mf—11147) Procedures of geological and seismological surveys for use in desing projects, construction and safe operation of nuclear power plants and heating plants in Czechoslovakia.** Simunek, P. (Energoprojekt, Prague (Czechoslovakia)). (Ceskoslovenska Komise pro Atomovou Energii, Prague). Mar 1987. 32p. (In Czech). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702328/JAW.

Bezpecnost Jadernych Zarizeni.; (no.1).

The techniques are proposed of surveys of nuclear power plant or heating plant sites, this of geological, geophysical and seismological surveys. The techniques are adapted to the geological and seismological situations in Czechoslovakia and to the potential and equipment of Czechoslovak survey organizations as well as to valid regulations governing geological surveys. Geological and seismological criteria are summed up precluding the construction of nuclear power plants or heating plants in certain localities. It is stated that currently, in Czechoslovakia, geological and seismological surveys can be provided for all stages of project design and construction of nuclear power plants in compliance with Czechoslovak and Soviet regulations and standards and with safety recommendations of the IAEA. The survey schedule shows that the jobs involved last for 1.5 to 5 years, depending on the type of site, geological and seismological and engineering conditions of the site, the locality and the area. Instrumentation is briefly characterized for automatic earthquake protection systems of nuclear power plants. (Z.M.). 4 tabs., 21 refs.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 27478, 27503, 27957

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 27478, 27503, 27923, 27946, 27957

27587 **(AERE-G—4378) FLOW3D model for below-core thermal mixing in the Oconee pressurised water reactor.** Splawski, B.A. (UKAEA Harwell Lab. Thermal Hydraulics Div.). Aug 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753085/JAW.

The computational fluid dynamics code FLOW3D is being used to develop a model for calculating the mixing of cold leg flows inside the vessel of a pressurised water reactor. To assess the capabilities of the model, a simulation was made of a thermal mixing test at the Oconee-1 Nuclear Station. The test measured temperature deviations at the core inlet produced by an imposed temperature difference between cold legs. Both the tests results and the simulation showed that most of the cold leg flows arrive unmixed at the core inlet. However, the simulation was unable to reproduce the asymmetric irregularities observed in the core inlet temperature distribution, and consequently the degree of mixing was under-predicted. Various sensitivity studies were carried out on the model, but these did not reveal the source of the asymmetry. It was therefore concluded that the asymmetry source was outside the scope of the model, but the model was nevertheless able to make plausible but pessimistic estimates of mixing.

27588 **(CNEN-DR—138/87) Evaluation of tests for coastdown of reactor coolant flow and measure of primary circuit flow of Angra-1 nuclear power plant.** Galetti, M.R.S.; Camargo, C.T.M.; Pontedeiro, A.C. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). May 1987. 77p. (In Portuguese). (GTT—01/87). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702230/JAW.

The Angra 1 Nuclear Power Plant first reload license was issued after several technical discussions among CNEN, FURNAS and KWU. During the license process CNEN has established that the plant could return to anormal operation if the requirements described in the letter CNEN-DExL-C 06/86 were satisfied. The requirements according to the CNEN Transient and Thermohydraulic Group Analysis were to do again the following tests: 'Primary Flow Measurement' to check if the excess flow measured in the first cycle was held; and Pump Coastdown' to check if the Westinghouse and KWU fuel elements are thermo-hydraulicaly compatibles during transients. The mixed core must keep at least the same safety margin presented on Angra 1 FSAR for the original core. The tests and the analysis of results are described.

27589 **(INIS-BR—1044) Reliabitity study of the accumulator system for Angra-1 reactor.** Santos Maciel, C.C.R. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1980. 133p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702308/JAW.

The realibility of the Accumulator System of Angra 1 reactor is studied. The fault tree techniques is use for identification and evaluation of the probability of occurrence of the possible failure modes of the system. The study has as a guide the report WASH 1400 in which the analysis of the reliability of a Tipical PWR reactor of USA. Comparisons between results obtained for Accumulator System of Angra 1 and that published in the report WASH 1400 for the Accumulator System of the Typical Reactor are done. Critiques to the methodology used in the reportd WASH 1400 and an analysis of the sensitivity of the system in relation with its components are also done.

27590 (INIS-BR—1057) Dynamic of vapor bubble growth in fields of variable pressure. Pedroso, H.K. (Minas Gerais Univ., Belo Horizonte (Brazil). Curso de Pos-graduacao em Ciencias e Tecnicas Nucleares). 1982. 61p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702320/JAW.

A mathematical model for the description of the growth from an initial nucleus of a vapor bubble imersed in liquid, subjected to a loss of pressure is presented. The model is important for analysing LOCA (Loss of Coolant Acident) in P.W.R. type reactors. Several simplifications were made in the phenomenum governing equations. With such simplifications the heat diffusion equation became the determining factor for the bubble growth, and the problem was reduced to solve the heat diffusion equation for semi infinite solid whose surface temperature is a well known function of time (it is supposed that the surface temperature is equal to the saturation temperature of the liquid at the system pressure at a given moment). The model results in an analytical expression for the bubble radius as a function of time. Comparisons with experimental data and previous models were made, with reasonable agreement.

27591 (UFRJ-COPPE-PEN—140) Application of the perturbation theory-differential formalism-for sensitivity analysis in steam generators of PWR type nuclear power plants. Sanders, R.M.G.; Andrade Lima, F.R. de; Alvim, A.C.M. (International Atomic Energy Agency, Vienna (Austria); Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear; Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). Jun 1987. 134p. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702483/JAW.

An homogeneous model which simulates the stationary behavior of steam generators of PWR type reactors and uses the differential formalism of perturbation theory for analysing sensibility of linear and non-linear responses, is presented. The PERGEVAP computer code to calculate the temperature distribution in the steam generator and associated importance function, is developed. The code also evaluates effects of the thermohydraulic parameter variation on selected functionals. The obtained results are compared with results obtained by GEVAP computer code . (M.C.K.).

2103 Power Reactors, Non-breeding, Graphite Moderated

27592 (IAEA-TECDOC—436, pp 213-234) HTR 100 industrial nuclear power plant for generation of heat and electricity. Brandes, S.; Kohl, W. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (Germany, F.R.); Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

Nuclear power plants operated with small high-temperature reactors provide an economic, environmentally favourable and reliable electricity and heat supply for industrial plants and communities. Based on their proven high-temperature reactor with pebble bed core, BBC/HRB have developed an HTR 100 plant which combines favourable capital costs and high availability. Due to the high HTR-specific standards this plant is especially well suited for siting near the end user. The safety concept is designed as to permit further operation of the plant or decay heat removal via the operational heat sinks in the event of maloperation and design basis accidents having a higher probability of occurrence. Thus high loads are avoided, especially in the reactor pressure vessel. In the event of hypothetical accidents the decay heat is removed from the reactor pressure vessel by radiation, conduction and convection to a concrete cooling system operating in natural convection. As an example of the new HTR 100 plant concept a twin-block plant design for extraction of industrial steam is presented. The reactor building is located in the center of the overall plant. It is a safety containment building with its inner structure detached from the outer shell for safe control of any external impacts. Its inner structure is designed identically for two reactor units. The nuclear steam supply system is included in a steel reactor pressure vessel in which all the primary components are integrated. All the safety-relevant systems are installed in the reactor building. The building configuration of the plant is characterized by clear functional structuring, short distances for systems and personnel, economic design, short construction period and low space requirement. (author). 10 figs, 1 tab.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

27593 (INFO—0168) Primary pump vibration under accident conditions. Guthrie, B.M.; Currie, T.C. (Davis Engineering Ltd., Ottawa, Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Jun 1984. 166p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702282/JAW.

This report presents the results of an international survey on the subject of vibration in nuclear primary coolant pumps due to two-phase flow, accident conditions. The literature search also revealed few Canadian references other than those of Ontario Hydro. Ontario Hydro's work has been extensive. Confidence in the mechanical integrity of the pumpsets is good, given the extent of the testing. However, conclusions with respect to piping integrity and thermal-hydraulic performance are difficult to determine due to the inexact geometry of the piping and the difficulties in estimating fluid conditions at the pump. The tests help to understand the phenomena and provide background information for analysis, but should be applied with caution to plant analyses. Much of the discussion in the report relates to pump head instability. This is perceived to be the most important flow regime causing vibration, as attested by the emphasis of the reviewed literature. A method for quantitative assessment of the forcing functions acting on the pump-piping system due to void generation and collapse is recommended. A relatively fundamental analytical approach is proposed, supplemented by reduced scale testing in the latter stages. 151 refs.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 27604, 27946, 27949

27594 Development of a sodium flow distributor for an advanced breeder reactor steam generator. Rusick, J.J.; Southards, W.T. (Nuclear Equipment Div., The Babcock and Wilcox Co., Barberton, OH (USA)). pp 73-84 of Maldistribution of flow and its effect on heat exchanger performance. Kitto, J.B.; Robertson, J.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Under United States Department of Energy (DOE) sponsorship, Babcock & Wilcox (B&W) has developed an advanced steam generator design for future breeder reactor power plants. This work, which began in 1977, involved developing a plant steam generator design and demonstrating the feasibility of the key design features using a 70 MWt prototype steam generator, being tested now. Development of sodium flow distributors and steam generator thermal/hydraulic performance analyses are presented.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

27595 Space nuclear power systems 1986; Proceedings of the Third Symposium, Albuquerque, NM, Jan. 13-16, 1986. El-Genk, M.S.; Hoover, M.D. Malabar, FL; Orbit Book Co., Inc. (1987). 499p. (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

The papers presented in this volume provide an overview of recent advances in the development of safe and reliable nuclear power systems for use in the exploration and utilization of space. Topics discussed include missions and applications, nuclear safety, reactors and shielding, thermal management, and energy conver-

sion. Other topics include systems integration, refractory alloys, radiation effects, testing, nuclear electric and nuclear propulsion, multimegawatt systems, and radioisotope generators.

2108 Economics

REFER ALSO TO CITATION(S) 27702

27596 A level playing field-obtaining consistent cost estimates for advanced reactor designs. Hudson, C.R.; Rohm, H.H.; Humphreys, J.R. (Oak Ridge National Lab., Oak Ridge, TN (USA)). pp 894-898 of Proceedings of the American power conference: Volume 49. Chicago, IL; Illinois Institute of Technology (1987). (CONF-870415—). Contract AC05-84OR21400.

From 49. annual American power conference; Chicago, IL, USA (27 Apr 1987).

A level playing field in sports is necessary to avoid a situation in which a team has an unfair advantage over its competition. Similarly, rules and guidelines for developing cost estimates can be established which, in effect, provide a level playing field whereby cost estimates for advanced power plant concepts can be presented on a consistent and equitable basis. As an example, consider the capital costs shown in Table 1. Both sets of cost are for the exact same power plant; Estimate 1 is expressed in constant dollars while Estimate 2 is presented in nominal or as-spent dollars. As shown, the costs in Table 1 are not directly comparable. Similar problems can be introduced as a result of differing assumptions in any number of parameters including the scope of the cost estimate, inflation/escalation and interest rates, contingency costs, and site location. Of course, the motivation for having consistent cost estimates is to permit comparison among various concepts. As the U.S. Department of Energy sponsors research and development work on several advanced reactor concepts in which expected cost is a key evaluation parameter, the emphasis in this particular endeavor has been in promoting the comparability of advanced reactor cost estimates among themselves and to existing power plant types. To continue with the analogy, the idea is to lay out the playing field and the rules of the contest such that each team participates in the match on an equal basis with the final score being solely determined by the inherent strengths and abilities of the teams. A description of the playing field and some of the more important rules will now be provided.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 27598

2202 Components And Accessories

REFER ALSO TO CITATION(S) 27605, 27737

27597 (BNL-NUREG—40815) Evaluation of risk effective STIs with specific application to diesels. Vesely, W.E.;Samanta, P.K.;Ginzburg, T. (Brookhaven National Lab., Upton, NY (USA); Science Applications International Corp., San Diego, CA (USA)). 1987. Contract AC02-76CH00016. 18p. (CONF-870973—2).

From Specialist meeting on improving technical specifications for nuclear power plants; Madrid, Spain (7 Sep 1987).

From a risk standpoint, the objective of surveillance tests is to control the risk arising from failures which can occur while the component is on standby. At the same time, risks caused by the test from test-caused failures and test-caused degradations need also to be controlled. Risk-acceptable test intervals balance these risks in an attempt to achieve an acceptable low, overall risk. Risk and reliability approaches are presented which allow risk-acceptable test intervals to be determined for any component. To provide focus for the approaches, diesels are specifically evaluated, however, the approaches can be applied not only to diesels, but to any component with suitable data. Incorporation of the approaches in personal computer (PC) software is discussed, which can provide tools for the regulator or plant personnel for determining acceptable diesel test intervals for any plant specific or generic application. The FRANTIC III computer code was run to validate the approaches and to evaluate specific issues associated with determining risk effective test intervals for diesels. Using the approaches presented, diesel accident unavailability can be more effectively monitored and be controlled on a plant-specific or generic basis. Test intervals can be made more risk effective than they are now, producing more acceptable accident unavailabilities. The methods presented are one step toward performance-based technical specifications, which more directly control risks.

2203 Fuel Elements

27598 Theoretical evaluation of consolidated rod temperature in spent fuel storage canister. Lee, Y.J. (Kaiser Engineers, Inc., Oakland, CA (USA)). pp 45-53 of Heat transfer problems in nuclear waste management. McAssey, E.V.; Schrock, V.E. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

An analytical method has been developed to calculate the cladding temperature of disassembled spent fuel rods in a dry storage canister. This method solves the two-dimensional, steady-state heat transfer of coupled conduction and radiation phenomena among closely compacted rods with an equilateral triangular pitch arrangement in a rectangular canister. A two-dimensional Laplace equation is solved by the collocation method to evaluate the conductive heat transfer relationship between rods and the radiant heat transfer relationship between rods is simplified by assuming that the reflected energy returns to the originated surface. The equations governing the conservation of energy among rods and canister surface can be solved by Newton-Raphson iteration method. A sample calculation has been presented utilizing the computer code developed based on this analytical method.

2204 Control Systems

REFER ALSO TO CITATION(S) 27528, 27598

27599 Thermal-hydraulic analysis of spent fuel storage systems. Rector, D.R.; Wheeler, C.L.; Lombardo, N.J. (Energy Sciences Dept., Pacific Northwest Lab., Richland, WA (USA)). pp 27-36 of Heat transfer problems in nuclear waste management. McAssey, E.V.; Schrock, V.E. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

This paper describes the COBRA-SFS (Spent Fuel Storage) computer code, which is designed to accurately predict flow and temperature distributions in spent nuclear fuel storage and transportation systems. The decay heat generated by spent fuel in a dry storage cask is removed through a combination of conduction, natural convection, and thermal radiation. One major advantage of COBRA-SFS is that fluid recirculation within the cask is computed directly by solving the mass and momentum conservation equations. In addition, thermal radiation heat transfer is modeled using detailed radiation exchange factors based on quarter-rod segments. The equations governing mass, momentum, and energy conservation for incompressible flows are presented, and the semi-implicit solution method is described. COBRA-SFS predictions are compared to temperature data from a spent fuel storage cask test, and the effect of different fill media on the cladding temperature distribution is discussed. The effect of spent fuel consolidation on cask thermal performance is also investigated.

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 27595

2209 Reactor Safety

REFER ALSO TO CITATION(S) 27599

27600 **(PB—88-167457/XAB) Chernobyl: health hazards from radiocesium following the Chernobyl nuclear accident. Report on a WHO (World Health Organization) meeting held at Guenzburg, Federal Republic of Germany on 9-12 June 1987.** (World Health Organization, Copenhagen (Denmark). Regional Office for Europe). 1987. 56p. (EH—24). NTIS, PC A04/MF A01.

See also PB—88-167465.

The meeting reviewed the health impact of exposure to both short- and long-lived radionuclides with emphasis laid on radiocesium. A review was also made of what measures national authorities can take in order to be prepared in the case of a nuclear accident, especially with regard to monitoring systems and pre- and post-accident education of the public.

27601 **(PB—88-167465/XAB) Nuclear accidents and epidemiology: reports on two meetings. Epidemiology related to the Chernobyl nuclear accident, and appropriate methodologies for studying possible long-term effects of radiation on individuals exposed in a nuclear accident.** (World Health Organization, Copenhagen (Denmark). Regional Office for Europe). 1987. 124p. (EH—25). NTIS, PC A06/MF A01.

See also PB—88-167457.

Contents include: epidemiology related to the Chernobyl nuclear accident (update on situation in the USSR, estimation of effects from calculated doses, specific organ sites worth considering in studies on cancer rates, prenatal effects apart from cancer, use of stable iodine prophylaxis); appropriate methodologies for studying possible long-term effects of radiation on individuals exposed in a nuclear accident (post-Chernobyl action in the USSR, administrative arrangements, study design, definition of study groups, data collection, dosimetry, effects, data management).

27602 **(PB—88-859004/XAB) Cold neutrons: sources and applications. January 1975-February 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 87p. NTIS PC N01/MF N01.

This bibliography contains citations concerning cold neutron sources from a research reactor, the use of liquid hydrogen or deuterium to enhance the thermal equilibrium, the storage and lifetime of cold neutrons, neutron guides and transport to direct the beam to a test specimen, and a few specific applications as nondestructive test instrumentation. Test instrumentation includes neutron radiography, microscopy, spectrometry, and diffractometry. Tests are related to crystal lattice studies in inorganic compounds, determination of inhomogeneities in thin films, and fundamental physics experiments. (Contains 188 citations fully indexed and including a title list.)

27603 **Sensitivity and uncertainty studies of the CRAC2 computer code.** Kocher, D.C.; Ward, R.C.; Killough, G.G.; Dunning, D.E. Jr.; Hicks, B.B.; Hosker, R.P. Jr.; Ku, J.Y.; Rao, K.S. (Oak Ridge National Lab., TN). *Risk Analysis;* **7**: No. 4, 497-507(Dec 1987). Contract AC05-84OR21400.

The authors have studied the sensitivity of health impacts from nuclear reactor accidents, as predicted by the CRAC2 computer code, to the following sources of uncertainty: (1) the model for plume rise, (2) the model for wet deposition, (3) the meteorological bin-sampling procedure for selecting weather sequences with rain, (4) the dose conversion factors for inhalation as affected by uncertainties in the particle size of the carrier aerosol and the clearance rates of radionuclides from the respiratory tract, (5) the weathering half-time for external ground-surface exposure, and (6) the transfer coefficients for terrestrial foodchain pathways. Predicted health impacts usually showed little sensitivity to use of an alternative plume-rise model or a modified rain-bin structure in bin-sampling. Health impacts often were quite sensitive to use of an alternative wet-deposition model in single-trial runs with rain during plume passage, but were less sensitive to the model in bin-sampling runs. Uncertainties in the inhalation dose conversion factors had important effects on early injuries in single-trial runs. Latent cancer fatalities were moderately sensitive to uncertainties in the weathering half-time for ground-surface exposures, but showed little sensitivity to the transfer coefficients for terrestrial foodchain pathways. Sensitivities of CRAC2 predictions to uncertainties in the models and parameters also depended on the magnitude of the source term, and some of the effects on early health effects were comparable to those that were due only to selection of different sets of weather sequences in bin-sampling.

27604 **Calamity at Chernobyl.** Malinauskas, A.P.; Buchanan, J.R.; Lorenz, R.A.; Yamashita, T. (Oak Ridge National Lab., Oak Ridge, TN (US)). *Mechanical Engineering;* **109**: No. 2, 50-53(Feb 1987).

The authors explain how the accident at Chernobyl was the result of a poorly prepared and unauthorized experiment. The article outlines the steps leading up to the accident and what was done immediately after it occurred.

27605 **Vibration testing of a 1/4-scale containment model.** Srinivasan, M.G.; Kot, C.A.; Hsieh, B.J. (Materials and Components Technology Div., Argonne National Lab., IL (USA)). pp 243-248 of Structural mechanics in reactor technology. Wittman, F.H. Accord, MA; A.A. Balkema Publishers (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Both the U.S. Nuclear Regulatory Commission (USNRC) and the Electric Power Research Institute (EPRI) have undertaken programs to validate soil-structure interactions analysis methods with data that include ground and structural response motions during natural earthquakes and structural response motions from low level vibration tests. The primary source of the data is the 1/4-scale containment building situated in Lotung in a seismically active region of Taiwan. The analysis validation program involves blind predictions of site and structural responses to the vibration test excitations and to a selected strong-motion seismic event, and the subsequent comparison of these predictions with corresponding measurements. The details of these programs are described more fully elsewhere. The present paper focuses on the vibration testing of the model containment structure and the determination of its dynamic characteristics from the experimental data. The 1/4-scale reinforced concrete containment structure, built by EPRI in cooperation with Taiwan Power Company, is located within an array of strong-motion seismographs, known as the SMART-1 array. Figure 1 shows a cross section of the structure. The structure is not a replica model of a typical nuclear power plant containment building. The roof slab had to be made massive to ensure that the fundamental frequencies of the model structure would fall within the frequency range of seismic excitation typical for the site.

25 ENERGY STORAGE

2501 Magnetic

27606 **(PB—88-859103/XAB) Superconducting magnetic energy storage (SMES). January 1972-February 1988 (Citations from the NTIS data base). Report for January 1972-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 67p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the technology and use of superconducting magnetic energy storage (SMES). The design, analysis, evaluation, and operation of SMES systems and equipment are discussed. Topics include utility scale SMES plants, SMES for transmission line stabilization, design and protection of superconducting magnets and coils, computer controlled

SMES systems, and fusion power reactors. (Contains 141 citations fully indexed and including a title list.)

2504 Capacitor Banks

REFER ALSO TO CITATION(S) 28104

2505 Flywheels

27607 **(AD-A—188686/0/XAB) Flywheel-powered mobile x-ray generator. Final report, 1 January 1982-31 October 1985.** Siedband, M.P. (Wisconsin Univ., Madison (USA)). 15 Oct 1985. 110p. NTIS, PC A06/MF A01.

Medical x-ray machines require high power for good images without motion artifacts. Power requirements are 5 kWp for small image fields and 15 kWp for larger fields, beyond the capacity of a small field generator. Conventional batteries and high-voltage capacitors can be used to accumulate energy but have practical limitations of size or affect x-ray beam quality. Circuits and mechanical components were developed which use small flywheels with certain alternators. Aircraft alternators were used as both motors and generators to accumulate energy at a slow rate and release the energy in a short burst suitable for operating a diagnostic x-ray machine. The flywheel alternator assembly accumulated energy from a 0.5 kW source and released it in bursts in excess of 35 kWp (regulated) and 50 kWp (unregulated).

2506 Thermal

REFER ALSO TO CITATION(S) 27565

2509 Batteries

REFER ALSO TO CITATION(S) 27630

27608 **(AD-A—188524/3/XAB) Fast protonic conducting solid electrolytes. Final report, 1 July 1982-30 June 1987.** Ratner, M.A.; Whitmore, D.H. (Northwestern Univ., Evanston, IL (USA)). 1987. 11p. NTIS, PC A03/MF A01.

Theoretical and experimental research on glassy and crystalline solid electrolyte materials was pursued. In lithium aluminum silicate it was found that the presence of disorder in the aluminosilicate framework can exert substantial effects on the conductivity of the lithium ion; in particular, the activation energy for ionic motion is substantially lower in the glassy phase than in the crystalline one, despite the greater disorder in the glass. This was explained in terms of reduced effects of interionic correlation in the disordered material compared to the rigidly alternating crystal. This substantial reduction in the localizing effects of ionic correlations should be operative in all glasses, and may account for enhancements of conductivity in stoichiometric glass compositions at relatively low temperatures. Complex impedance spectroscopy, magnetic resonance, vibrational spectroscopy, and differential anomalous scattering techniques were used to study local structures in silver selenide-germanium selenide glasses. The data seem to show the coexistence of well-defined local order with typical glassy randomness. Diffusion measurements on both uranyl phosphate and beta-alumina protonic electrolytes were completed using nuclear magnetic resonance spectroscopy. The results strongly suggest that the simple for the Grotthus mechanism is not operative here. A detailed study of the transport properties of the proton-conducting hydrogen-uranyl-periodate-water glasses was made. The protonic conductivity and diffusivity are dependent on the partial pressure of water vapor in the surrounding atmospheric are photosensitive.

27609 **(AD-A—188751/2/XAB) Case study of the development of a military specification - zirconium powder for thermal batteries. Final report.** Burgess, M.T. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Oct 1987. 19p. (MTL-TR—87-55). NTIS, PC A03/MF A01.

Thermal batteries are used as the critical power source in nuclear fuses, missiles, and aircraft. Heat sources in thermal batteries use a fine zirconium powder. This report focuses on the zirconium problem and the development of a military specification for zirconium powder as produced by the magnesium reduction method.

29 ENERGY PLANNING AND POLICY

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 27468, 27469, 27654

27610 **(PB—88-166871/XAB) Community and economic development for counties (Alachua County, Florida; Travis County, Texas; and nine parrishes in northwest Louisiana). Final report.** Davis, R.A. (National Organization of Black County Officials, Inc., Washington, DC (USA)). 31 Dec 1987. 156p. NTIS, PC A08/MF A01.

See also PB—87-157392; Portions of this document are not fully legible.

For three years, the National Organization of Black County Officials has accepted the responsibility of providing technical assistance for economic development to Black County officials. The report covers its assistance to county commissioners in Alachua County, Florida and Travis County, Texas and to police jurors in nine mostly rural parishes in Northwest Louisiana. The project was designed to develop leadership skills and capacities among black officials to undertake and implement development projects and to promote effective citizen participation in community and economic development. On site assistance has been an important factor helping to alleviate the isolation of officials in Northwest Louisiana. In conducting the project, NOBCO developed a network of informed county officials who share information with each other about economic-development programs and strategies that work in various types of settings.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 27978, 28118, 28188, 28203, 28204, 28205, 28212, 28229, 28230, 28231, 28232, 28233, 28234, 28235, 28236, 28237, 28238, 28273, 28274

27611 **(AD-A—187727/3/XAB) Hazardous-waste staff-assistance survey, Pope AFB, Los Angeles. Final report, 1-11 June 1987.** Tetla, R.A.; Spakowicz, M.R. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Nov 1987. 62p. (USAFOEHL—87-146EQ0164LHH). NTIS, PC A04/MF A01.

At the request of HQ MAC/SGPB, the USAFOEHL conducted a hazardous-waste staff-assistance survey at Pope AFB from 1 Jun 87 to 11 Jun 87. The scope of this survey was to address hazardous waste management practices and explore opportunities for hazardous-waste minimization. The survey team performed a shop-by-shop evaluation of chemical-waste-management practices as well as met with hazardous-waste managers and engineers to discuss the hazardous waste program. Results of the survey showed that the hazardous-waste program at PAFB is small and works fairly well. With some refinements, the base has an opportunity to have an excellent program. Environmental Coordinator (DEEV), has the responsibility of training shop personnel, inspecting accumulation sites, reviewing finalized manifests and maintaining records. DEEV is not involved with the specific day-to-day logistical details of the waste disposal.

27612 **(AD-A—188175/4/XAB) Effects of a NBC (nuclear, biological, and chemical) nutrient solution on physiological and psychological status during sustained activity in the heat. Final report, February-March 1987.** Rose, M.S.; Francesconi, R.P.; Levine, L.; Shukitt, B.; Munro, I. (Army Research Inst. of Environmental Medicine, Natick, MA (USA)). 17 Jul 1987. 244p. (USARIEM-T—25-87). NTIS, PC A11/MF A01.

Soldiers involved in nuclear, biological, and chemical (NBC) warfare may be encapsulated in MOPP4 ensemble for up to 24 hours. In that configuration the soldier is in a fasting state unless he can move to a decontaminated area to eat. The purpose of this

study was to determine if a nutrient solution containing 2.34% carbohydrate and 24.1 mEq sodium per liter (NBC nutrient solution) would be more effective than a control solution of colored and flavored water in maintaining the physiological and psychological status of a person under thermal conditions that simulate MOPP4 encapsulation. Fluid intake was encouraged and the subjects maintained hydration fairly well. The results of this study indicated that water and the NBC Nutrient solution were equally effective in maintaining hydration and physiological status under hot dry conditions. The NBC Nutrient solution was more palatable, lowered symptom intensity, and improves mood; cognitive performance was not improved.

27613 **(PB—88-148085/XAB) EPA's (Environmental Protection Agency's) waste-minimization research program.** Dial, C.J. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Dec 1987. 9p. (EPA—600/D-87/365). NTIS, PC A02/MF A01.

Waste minimization is viewed by the Environmental Protection Agency as a desirable and viable alternative to hazardous-waste disposal. The Hazardous Waste Engineering Research Laboratory, in conjunction with the Office of Solid Waste, is developing a Waste Minimization Program for implementation in Fiscal Year 88. Information on these efforts is discussed.

27614 **(PB—88-163753/XAB) Health impact of low indoor temperatures: report on a WHO (World Health Organization) meeting held at Copenhagen on November 11-14, 1985. Environmental Health Series.** (World Health Organization, Copenhagen (Denmark). Regional Office for Europe). 1987. 37p. (EH—16). NTIS, PC A03/MF A01.

The meeting reviewed the results of studies in the area of low indoor temperatures that had been carried out by WHO collaborating institutes. It also considered whether sufficient evidence from scientific studies and epidemiological investigations was available to demonstrate an adverse effect on health of low indoor temperatures, especially in high-risk groups (preschool children, elderly, disabled and sick). Recommendations were made on indoor temperatures below which the health of the general population and high-risk groups may be endangered. It also reviewed the basic parameters and methodology for assessing the thermal environment.

27615 **(PB—88-163787/XAB) Waste minimization: hazardous and non-hazardous solid waste (1980 to present). Information guide 1980-87.** Richard, S.A.; Berger, A. (Environmental Protection Agency, Washington, DC (USA). Information Management and Services Div.). Sep 1987. 187p. (EPA/IMSD—87/007). NTIS, PC A09/MF A01.

The minimization of hazardous and non-hazardous solid waste has become an increasingly important topic in recent years. More and more, people are becoming concerned that the country's landfills are nearing capacity, and that hazardous and non-hazardous solid wastes pose a severe threat to human health and the environment. Federal, State, and local governments have been grappling with methods for minimizing wastes through source reduction and recycling. This bibliography, which also reflects current interest in used oil, includes citations from journal articles, books, government reports and bibliographies, conference proceedings, scientific and technical papers, and speeches. Citations were selected for their relevance to EPA information needs. The bibliography is divided into sections on Hazardous Waste, Used Oil, and Non-Hazardous Solid Waste.

27616 **(PB—88-913800/XAB) Resource conservation recovery act notification data file. Data file.** Levy, S.; Murray, P.; Sprow, W. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 31 Dec 1987. mag tap. NTIS Subscription.

Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Available on subscription, North American Continent price $2000.00/year, each quarterly issue $500.00; all others write for quote. For price at 6250 bpi density, call NTIS Computer Products.

The file contains data compiled for the Resource Conservation Recovery Act. Notification of Hazardous Waste Activity, EPA Form 8700-12, was used to collect the data. The file was updated with information compiled from the Application for a Hazardous Waste Permit, EPA Form 3510-3. The data include names and addresses of the facility owner and operator, as well as the facility contact name and number. The data indicate whether a facility is a generator, treatment/storer/disposer, and/or transporter of hazardous waste. There is also a listing of code numbers of waste handled taken from 40 CFR, Part 261. The file is produced on a quarterly basis.

27617 **Integrating uncertainty and interindividual variability in environmental risk assessment.** Bogen, K.T.; Spear, R.C. (Lawrence Livermore National Lab., CA). *Risk Analysis;* 7: No. 4, 427-436(Dec 1987). Contract W-7405-ENG-48.

An integrated, quantitative approach to incorporating both uncertainty and interindividual variability into risk prediction models is described. Individual risk R is treated as a variable distributed in both an uncertainty dimension and a variability dimension, whereas population risk I (the number of additional cases caused by R) is purely uncertain. I is shown to follow a compound Poisson-binomial distribution, which in low-level risk contexts can often be approximated well by a corresponding compound Poisson distribution. The proposed analytic framework is illustrated with an application to cancer risk assessment for a California population exposed to 1,2-dibromo-3-chloropropane from ground water.

27618 **Use of risk assessment methods in the certification of decontaminated buildings.** Seiler, F.A.; Davis, H.T.; Kominsky, J.R.; Ronan, R.J.; Kowka, C.D. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (USA)). *Risk Analysis;* 7: No. 4, 487-495(Dec 1987). Contract AC04-76EV01013.

Accidental events such as fires, explosions, and leaks often result in large-scale contaminations of buildings with toxic chemicals. After decontamination, the certification for original use requires testing for residual contamination. The two basic kinds of sampling plans in use up to recently both fall short of the required performance. Their deficiencies are analyzed in terms of the scientific questions implicit in both the sampling plan and the subsequent statistical evaluation. A sampling strategy of a new kind is proposed and discussed in the same context. It is motivated by concern for the long-term safety of the building's occupants and is, therefore, based on factors important in risk assessment. Three different sampling plans are derived in the framework of this methodology, two of which have already been used in actual certification proceedings.

2904 Natural Resources

REFER ALSO TO CITATION(S) 27429, 27465, 27616, 28230, 28231

27619 **(PB—88-174677/XAB) Resource recovery and waste reduction: third report to Congress.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 1975. 116p. (EPA/SW—448). NTIS, PC A06/MF A01.

Also available from Supt. of Docs.; Portions of this document are not fully legible.

The Third Report to Congress reviews the status of resource recovery and waste reduction in the United States and findings of EPA studies and investigations that were available during 1974. It reflects the widening interest and knowledge, during the time period, that developed in these areas as well as the various unknowns, uncertainties, and barriers that remain.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 27526, 27527, 27677, 28202

27620 **(PB—88-157581/XAB) Technology application: the role of the economic developer in improving the competitiveness of existing industry. Final report.** (American Economic Development Council Educational Foundation, Schiller Park, IL). Oct 1987. 100p. NTIS, PC A05/MF A01.

This AEDC Educational Foundation handbook presents for the economic developer insights into the decision-making processes of business as a basis for determining appropriate roles for the economic developer to assist business in applying technology. The focus of assistance from the economic developer to existing business is on technology application as a means to improve the competitive market position of a business. The multiple facets of technology include (but are not necessarily limited to): expertise and knowledge (including that embedded in qualified, experienced staff), hardware and software; application in manufacturing processes, in products, themselves, in marketing, management, distribution and virtually all aspects of a business; and the most-sophisticated, state-of-the-art, or pacing developments as well as the apparently more-mundane, proven technology.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 27624

27621 **(PB—88-901900/XAB) Government Research and Development Summaries: Nuclear, Te, Ti Project Briefs. Monthly report.** (CSR, Inc., Washington, DC (USA). Power Information Center). 1988. ap. NTIS Subscription.

Supersedes PB—87-901900; Paper copy available on subscription $80.00/year. U.S. sales only, excluding embassies. Additional subject categories available at a discount. Also available in single copies.

Nuclear, Te, Ti Project Briefs describe the status of all R&D programs submitted to the Power Information Center by the government sponsors in energy conversion from fission, fusion, and radioisotope power sources and other thermal systems that use thermionic systems. These briefs also follow related investigations of plasma dynamics. The document is not to be reproduced, in whole or in part, for dissemination outside your own organization nor may it be reproduced for advertising or sales promotion purposes.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 27667

2910 Conservation

REFER ALSO TO CITATION(S) 27633, 27634, 27642, 27645, 27646, 27647, 27649, 27650, 27652

27622 **Amending the National Energy Conservation Policy Act to improve the federal energy management program and for other purposes. Senate, One Hundredth Congress, First Session, December 15, 1987.** Washington, DC; Government Printing Office (1987). 23p.

The Committee on Energy and Natural Resources, to which was referred the bill (S. 1382) to amend the National Energy Conservation Policy Act to improve the Federal Energy Management program and for other purposes, having considered the same, reports favorably thereon with amendments to the text and recommends that the bill, as amended do pass. The 16 amendments are listed. As ordered reported the committee feels S. 1382 would strengthen the Federal government efforts to promote energy conservation and efficiency.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 27648

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 27622

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 27429, 27452, 27466, 27468, 27469, 27579, 27580, 28235, 28237, 28238

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 27685

2960 Electric Power

REFER ALSO TO CITATION(S) 27623, 27624, 27625, 27641

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 27546, 27575, 27657, 28236

30 DIRECT ENERGY CONVERSION

27623 **(PB—88-901700/XAB) Government Research and Development Summaries: Electrical Project Briefs. Monthly report.** (CSR, Inc., Washington, DC (USA). Power Information Center). 1988. ap. NTIS Subscription.

Supersedes PB—87-901700; Paper copy available on subscription $125.00/year. U.S. sales only, excluding embassies. Additional subject categories available at a discount. Also available in single copies.

Electrical Project Briefs describe the status of all R&D programs submitted to the Power Information Center by the government sponsors in energy conversion to electrical forms (including electrical energy control) by electromechanical, electromagnetic, electrostatic, magnetohydrodynamic, electronic, and solid-state devices excluding photovoltaic and photoemissive devices. Specific attention is devoted to magnetohydrodynamics, power conditioning, and superconductivity. The document is not to be reproduced, in whole or in part, for dissemination outside your own organization nor may it be reproduced for advertising or sales promotion purposes.

27624 **(PB—88-902100/XAB) Government Research and Development Summaries: Chemical, Electrical, Mechanical, Nuclear, Te, Ti, Solar, Magnetohydrodynamic, and Systems Project Briefs. Monthly report.** (CSR, Inc., Washington, DC (USA). Power Information Center). 1988. ap. NTIS Subscription.

Supersedes PB—87-902100; Paper copy available on subscription $550.00/year. U.S. sales only, excluding embassies. All categories also available individually and monthly.

The Government Research and Development Summaries now available from NTIS are project Briefs prepared by the Interagency Advanced Power Group. The authors describe the status of all programs in the fields of advanced power research, development and engineering. Members of the Interagency Advanced Power Group (IAPG) are the U.S. Army, Navy, and Air Force, U.S. Department of Energy and the National Aeronautics and Space Administration (NASA). Their cooperative effort monitors government-funded research and development producing project briefs in the following categories. Chemical, Electrical, Mechanical, Nuclear, TE, TI, Solar, and Magnetohydrodynamic and Systems. Each project brief contains title; project description; contract number, period, probable completion date and funding; principal investigator name and telephone number; contractor name and address; direct-

ing agency and index terms. Subscribers who receive any of the project brief packages will also receive the semi-annual IAPG Project Briefs by Field of Interest, and the Annual Completed or Cancelled Compilation and Cumulative Annual Project Brief Subject Index which are combined into a single publication.

27625 **(PB—88-910700/XAB) Government Research and Development Summaries: Systems Project Briefs. Monthly report.** (CSR, Inc., Washington, DC (USA). Power Information Center). 1988. ap. NTIS Subscription.

Systems Project Briefs describe the status of all R&D projects submitted to the Power Information Center by the government sponsors in complete electric power/energy systems, from source to user. The document is not to be reproduced, in whole or in part for dissemination outside your organization nor may it be reproduced, in whole or in part, for advertising or sales promotion purposes.

3001 Mhd Generators

27626 **(PB—88-902200/XAB) Government Research and Development Summaries: Magnetohydrodynamic Project Briefs. Monthly report.** (CSR, Inc., Washington, DC (USA). Power Information Center). 1988. ap. NTIS Subscription.

Supersedes PB—87-902200; Paper copy available on subscription $80.00/year. U.S. sales only, excluding embassies. Additional subject categories available at a discount. Also available in single copies.

Magnetohydrodynamic Project Briefs describe the status of all R&D programs submitted to the Power Information Center by the government sponsors in energy conversion involving the magnetohydronamic (MHD) interaction between electromagnetic fields and electrically conducting fields, including fuels, materials, plasma dynamics, and combustion. The document is not to be reproduced, in whole or in part, for dissemination outside your own organization nor may it be reproduced for advertising or sales promotion purposes.

27627 **Overview of DOE and SDIO MHD program activities at PETC.** Carabetta, R.A.; Chambers, H.F. Jr.; Staats, G.E.; Elia, G.G.; Owens, W.R. (Pittsburgh Energy Technology Center, PA (USA); Gilbert/Commonwealth, Inc., Gaithersburg, MD (USA)). pp 11 of Aerospace sciences meeting. Reno, NV; AIAA (1988). (AIAA-Paper—88-0720; CONF-880139—).

From 26. AIAA aerospace conference; Reno, NV, USA (10 Jan 1988).

Two major MHD programs being implemented by the Pittsburgh Energy Technology Center (PETC) are described. One is a program for the development of commercial coal-fired electric power generation, while the other is a program to assess the feasibility of using MHD devices as space-based electric power sources for military applications. The different phases of the programs, their present status, and the facilities being employed are addressed.

27628 **Monolithic fuel cell development.** Fee, D.C.; Blackburn, P.E.; Busch, D.E.; Claar, T.D.; Dees, D.W.; Dusek, J.; Easler, T.E.; Ellingson, W.A.; Flandermeyer, B.K.; Fousek, R.J. New York, NY; American Institute of Chemical Engineers (1987). 9p. (CONF-870822—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

Technical Paper 11D.

A new fuel cell design, called the "monolithic fuel cell," is being developed at Argonne National Laboratory. The monolithic design employs the same thin ceramic components used in other oxide fuel cells in a strong, lightweight honeycomb structure of small cells, and thus can achieve very high power per unit mass or volume. The light weight and low volume, as well as the efficiency and reliability of electrical systems, are advantageous is space and terrestial systems.

3003 Thermoelectric Generators

REFER ALSO TO CITATION(S) 27621

3004 Thermionic Converters

REFER ALSO TO CITATION(S) 27621

3005 Fuel Cells

REFER ALSO TO CITATION(S) 27472, 27608, 28492

27629 **(PB—88-171764/XAB) Development of molten carbonate fuel cell - result of 10-kW class stack test.** Sato, S.; Yamamasu, Y.; Koga, M.; Yoshida, T.; Shiozawa, S. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1987. 7p. NTIS, PC E04.

Text in Japanese; Included in IHI (Ishikawajima-Harima Heavy Industries), Vol. 27, No. 6, 321-327(Nov 1987).

IHI started development of the Molten Carbonate Fuel Cell (MCFC) in 1983 and since then has been conducting studies on essential technologies to commercialize MCFC. Recently, IHI succeeded in testing power generation of the 10-kW class MCFC with a parallel-flow stack structure consisting of 29 cells, each cell measuring 3600 sq cm and having an internal manifold. The result was that the 12.4 kW of power at 150 mA/sq cm was successfully generated and the mean cell voltage was 0.798 V. Temperature distribution was almost symmetrical along the gas flow and showed good cooling performance characterized by the parallel-flow method. The experiment verifies that these technologies are applicable to a large stack and it substantiated the fundamental technology for 100- to 1000 kW MCFC systems.

27630 **(PB—88-901600/XAB) Government Research and Development Summaries: Chemical Project Briefs. Monthly report.** (CSR, Inc., Washington, DC (USA). Power Information Center). 1988. ap. NTIS Subscription.

Supersedes PB—87-901600; Paper copy available on subscription $125.00/year. U.S. sales only, excluding embassies. Additional subject categories available at a discount. Also available in single copies.

Chemical Project Briefs describe the status of all R&D programs submitted to the Power Information Center by the government sponsors in electrochemical systems, including chemical batteries, biochemical devices, simple fuel-cell systems, chemical regenerative fuel-cell systems, and thermal energy storage. The document is not to be reproduced, in whole or in part, for dissemination outside your own organization nor may it be reproduced, in whole or in part, for advertising or sales-promotion purposes.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

REFER ALSO TO CITATION(S) 27468, 27470, 28187

27631 **(AD-A—188134/1/XAB) Evaluation of building design/analysis software for microcomputers. Final report.** Bahnfleth, W.; Herron, D.; Ruby, K. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Nov 1987. 34p. (CERL-TR-E—88/01). NTIS, PC A03/MF A01.

This report documents the results of an evaluation of microcomputer-based programs for building energy analysis and heating, ventilating, and air-conditioning system designs. The programs were evaluated for ease of use and calculation performance. The study showed that all programs evaluated were suitable for use by building designers and that no program package could be identified as clearly the best. Each program has a unique set of strengths and weaknesses. Load-estimating and duct-sizing software packages were tested by simple design problems. Load-estimating software

performed consistently, although differences in algorithms resulted in clear discrepancies among cooling-load predictions. Duct-design programs did not agree particularly well, especially with respect to pressure-drop calculations. Further performance evaluations are necessary. Information in this report should help designers select the program packages appropriate for their experience level and design application.

27632 **(EUR—10319) High performance single screw heat pump.** (Commission of the European Communities, Luxembourg). 1985. 18p. (In French). NTIS (US Sales Only), PC A03/MF A01;1. Order Number DE88752583/JAW.

The present study aims to perfect a compressor system for a heat pump intended for heating systems, using electrical power of 30kW and producing therefore about 100 thermal kW. Intended for communal living quarters and service industries, such a system must be silent, free from vibrations, reliable and robust. After a year of fruitless research, the study led to the perfection and experimental testing of a single screw compressor without oil injection, using an asymmetrical economizing device, and capable of accelerated de-frosting through the use of a refrigerating liquid. The performance of the compressor, although already superior to that of classic piston machines, can be still further improved thanks to the results of a simulation, allowing the development of optimum criteria for adjustment at full output and partial load. The effect of the characteristics of the compressor on the functioning of the heat pump system is studied and applied to two different climates representative of the countries of the Community.

27633 **(PB—88-157201/XAB) Potential for energy savings in commercial premises in Sweden: improved energy efficiency in five office buildings by upgrading the energy systems.** Sundbom, L.; Nilson, A.; Munther, K. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 46p. (D—18:1987). NTIS, PC E03/MF A01.

The Swedish Council for Building Research deemed three different types of buildings to be of special interest in the field of energy management; these are schools, office, and commercial buildings, and blocks of flats. The purpose of the demonstration project has been to carry out a full-scale series of energy-saving measures, evaluate the resultant savings in energy consumption by means of on site measurements and, finally, to analyze the economic feasibility and profitability of the project.

27634 **(PB—88-163068/XAB) Thermodynamic heating, the method of the future.** Lorentzen, G. (SINTEF, Trondheim (Norway)). 25 Sep 1987. 11p. (STF—11-A87059). NTIS, PC E03/MF E03.

Heat pumps are used extensively wherever conditions are favorable; in water-power countries, special industrial application, and where combination with a cooling requirement is possible. In order to make it universally accepted for house heating even in fuel-energy economies, a considerable improvement in efficiency is required. Some indication of how this can be realized are given.

27635 **(PB—88-168638/XAB) Design of energy -efficient houses in People's Republic of China including utilization of passive solar energy. Heat balance of heated and passive residential buildings in China.** Adamson, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 196p. (D—5:1987). NTIS, PC E07/MF A01.

Contents include: calculation of the heat balance of a building; heat balance of a heated building; heat balance of a passive building; tables.

27636 **(PB—88-170865/XAB) Heating and hot-water systems for multi-family buildings: an energy conservation manual for owners, operators, and manager.** (New York City Dept. of Housing Preservation and Development (USA)). Jul 1986. 59p. NTIS, PC A04/MF A01.

This analysis included an inspection of the heating plant and hot-water system; inspection of the heating and hot-water distribution pipes; inspection of windows and doors in common areas and in representative apartments to determine condition and need for caulking, weatherstripping, and door sweeps; an inspection of radiators in representative apartments; and an inspection of electrical outlets on exterior walls, and faucets and showerheads in representative apartments to determine current condition and feasibility of installation of draft blockers, low-flow showerheads, and faucet aerators.

27637 **(PB—88-173026/XAB) Residential/commercial energy systems: 1982-1983 research status report. Topical report.** (Gas Research Inst., Chicago, IL (USA)). 1984. 229p. (GRI—83/0087). NTIS, PC A11/MF A01.

This 1982-1983 status report discusses ongoing and planned activities in GRI's Residential/Commercial Energy Systems Subprogram which is part of the Efficient Utilization Program. The program's objective is to develop efficient gas-using equipment that meets environmental standard at a cost and quality competitive with alternative-energy forms. Twelve project areas are reviewed: residential heating systems, commercial heating systems, residential heat pumps and prime movers, commercial heat pumps and prime movers, residential appliances, commercial appliances, cooling system, building/system performance, phosphoric acid fuel cells, advanced fuel-cell concepts, energy cogeneration systems, and gas/solar integrated systems. Presented are objectives and goals, accomplishments, strategy and basis for each project area, and a status review sheet for projects within the project area.

27638 **(PB—88-859541/XAB) Urea formaldehyde in building materials. January 1973-February 1988 (Citations from the Rubber and Plastics Research Association data base). Report for January 1973-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 134p. NTIS PC N01/MF N01.

Supersedes PB—87-851952.

This bibliography contains citations concerning regulations, standards, safety, and applications of formaldehyde resin compositions in the building industry. Urea formaldehyde is emphasized; however, phenol formaldehyde and melamine formaldehyde are also considered for such applications as thermal insulation, bonding agents, and composite construction materials. Ramifications of state and federal legislation, substitute materials, and toxicology studies are included. (This updated bibliography contains 330 citations, 10 of which are new entries to the previous edition.)

27639 **Techniques for in situ determination of thermal resistance of light weight board insulations.** Courville, G.E.;Beck, J.V. (Energy Div., Oak Ridge National Lab., Oak Ridge, TN (USA)). pp v of Heat transfer in buildings and structures. Kuehn, T.H.;Hickox, C.E. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—). Contract AC05-84OR21400.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Four techniques for determining the in situ thermal resistance of rigid board insulation installed in conventional low-sloped roofs are described and compared. All techniques use measured temperature distributions and heat fluxes in the roof systems. The limitations of the techniques are discussed. Test results are presented to allow a comparison of the methods.

3202 Transportation

REFER ALSO TO CITATION(S) 27446, 27451

27640 **(AD-A—188970/8/XAB) Analysis of the aircraft flying-hour program at the Pacific Missile Test Center. Master's thesis.** Byrne, V.J. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1987. 85p. NTIS, PC A05/MF A01.

This thesis is an analysis if the flight-hour cost program at the Pacific Missile Test Center (PMTC). The method by which PMTC computes aircraft flight-hour rates is compared to the techniques used by the Naval Air Test Center and the Naval Weapons Center. A new approach to computing aircraft rates is proposed in this report. Using historical cost data, regression analysis is used to derive a rate per hour flown for fuel consumption. Based upon these data, no correlation exists between aircraft flight-hours and aircraft parts costs. A decision support system (DSS) is also pro-

posed herein to assist in the calculation of the flight hour rates. This DSS can also be used as a budget and as a vehicle to track program cost and schedule variances. It is recommended that a follow-on analysis be conducted to ascertain whether or not true correlation exists between flight hours and aircraft parts costs. Under the current budget system, funds for parts are requested per hour in the Navy and Marine Corps flying-hour program.

27641 **(PB—88-148267/XAB) Reduction of peak-power demand for electric rail-transit systems. Final report.** Uher, R.A.; Sathi, N. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Rail Systems Center). Dec 1983. 47p. NTIS, PC A03/MF A01.

Library of Congress catalog card No. 83-51764.

The objective of the research was the identification of systematic methods and procedures by which rail-transit systems can lower the power-demand component of the electric bill. Four rail-transit systems were selected to examine energy-related data and policies, to simulate the energy-use pattern, and to develop more-general guidelines for energy management in rail transit. Estimates of overall costs and effectiveness of load-management methodologies were made. The cost and benefit of load management is extremely site-specific. A series of guidelines that define an overall transit energy-management program were developed as part of the report.

27642 **(PB—88-149364/XAB) Traffic management during major highway reconstruction: abbreviated case studies. Final report, 1981-1986.** Scott, C.P. (Federal Highway Administration, McLean, VA (USA). Office of Safety and Traffic Operations Research and Development). Jul 1987. 94p. NTIS, PC A05/MF A01.

See also PB—83-219063.

Traffic-management strategies have been implemented to move people, not vehicles, through and around reconstruction activities. These strategies include: public information and community liaison activities (e.g., task forces, meetings, media campaigns, brochures); work-zone traffic controls (e.g., standard devices and practices, incident detection and management); traffic engineering and operational improvements on alternate routes (e.g., turn lanes, channelization, timing and coordinating traffic control signals, traffic control officers); ridesharing and related incentives (e.g., carpooling, vanpooling, buses, park-and-ride lots, HOV lanes, preferential parking); and contract items (e.g., incentives/disincentives, nighttime and off-peak work hours). The report documents traffic management strategies that have been implemented in 17 U.S. cities.

27643 **(PB—88-151030/XAB) Characterization of locomotive tractive effort from the electrical power to the traction motors. Final report, May-December 1983.** Wilson, N.; Rownd, K.; Dembosky, M.; Washburn, R. (Association of American Railroads, Pueblo, CO. Transportation Test Center). Mar 1986. 126p. (TTC—042(FAST-FR86)). NTIS, PC A07/MF A01.

Experiments to be performed on the FAST track at the Transportation Test Center required a method of measuring train resistance and related fuel consumption in moving the train. Previous experiments had shown that the Roll Dynamics Unit (RDU) in the Rail Dynamics Laboratory might be used as a dynamometer to measure the performance of a locomotive. A GP40-2 locomotive was already being used on the RDU as a test bed for a fuel flowmeter. The locomotive was instrumented so that input power to the traction motor armatures was calibrated to measure train resistance by developing accurate performance curves that related traction-motor armature input to tractive power. Field trials with the locomotive hauling test, consisting of cars with ordinary three-piece trucks and two types of radial trucks, were performed to test the instrumentation package. Results showed the system to be reliable, durable, and accurate. In addition, the use of radial trucks, or truck lubrication, was shown to be beneficial in reducing train resistance.

27644 **(PB—88-155015/XAB) Improving decision making for major urban-transit investments. Final report.** Stowers, J.R.; Reno, A.T.; Boyar, V.W. (System Design Concepts, Inc., Washington, DC (USA)). Dec 1983. 57p. NTIS, PC A04/MF A01.

Library of Congress catalog card No. 84-50027.

This report contains the research results of an assessment of federal, state, and local decision-making processes for major urban mass-transportation investments obtained by evaluating recent experiences with alternative analysis. Identified in the assessment are potential improvements in policy, procedures, and use of technical information. Recommendations on planning procedures for use by federal, state, and local agencies are also included. The report is designed to provide guidance to all transit professionals involved in ongoing and future analysis of transit and highway alternatives for urban areas.

27645 **(PB—88-160569/XAB) Managing transit ridership with short-term economic incentives. Final report.** Everett, P.B.; Watson, B.G.; Gurtler, M.D. (Pennsylvania State Univ., University Park (USA). Davey Lab.). Aug 1982. 55p. NTIS, PC A04/MF A01.

This study provides an overview of the variety, type, and nature of short-term economic-incentive programs that have been introduced by transit properties over the last few years. To accomplish this, a framework for understanding short-term economic incentives is presented. The framework has been derived from psychological research and from contemporary marketing and management perspectives. Second, a series of case studies is examined and evaluated. Finally, recommendations of the best ways to implement a short-term economic-incentive program are made. A decision matrix is set up to help the reader decide whether to try a short-term economic-incentive program, or other possibilities like a change in service level. The document includes information on the types of incentives that might be offered, the length of time such programs need to be in effect, the time and place to distribute incentives, and the reasons for distributing them. In addition, ways are described for evaluating the effectiveness of short-term economic-incentive programs and for determining the cost and benefits of such procedures.

27646 **(PB—88-160999/XAB) New directions in urban transportation: private/public partnerships. Final report.** (Rice Center, Houston, TX (USA)). Nov 1985. 82p. NTIS, PC A05/MF A01.

Also available from Supt. of Docs.

The report looks at innovative ideas that promise to bring about changes in organization, financing, and delivery of local transportation. The report discusses developer and property-owner involvement in transportation; business involvement; community-based and cooperative transportation efforts; private participation in financing and private operation at transportation services. The report should be useful to transit authorities, and those involved in the planning and operation of the urban-transportation systems.

27647 **(PB—88-161500/XAB) Evaluation of the cost effectiveness of HOV (high-occupancy vehicle) lanes. Final report.** Ulberg, C. (Washington State Transportation Center, Seattle (USA)). Jul 1987. 22p. NTIS, PC A03/MF A01.

The cost effectiveness of high-occupancy vehicle (HOV) lanes was analyzed by comparing the costs and benefits of existing HOV lanes with the hypothetical alternatives of doing nothing or adding a lane for general traffic. Three specific sites in the Seattle area were studied. A life-cycle costing approach was used. The main result of the study was that for the three locations studied the construction of HOV lanes was the most cost-effective alternative.

27648 **(PB—88-161518/XAB) Inexpensive travel demand techniques. Final report.** Khisty, C.J.; Rahi, M.Y. (Washington State Univ., Pullman (USA). Dept. of Civil and Environmental Engineering). Sep 1987. 75p. NTIS, PC A04/MF A01.

The report examines the applicability of simplified travel demand models suitable for small urban areas. The scope of the research is limited to simplified travel demand forecasting techniques that make use of routinely collected traffic ground counts. A total of thirteen methods are examined, of which four are discussed in detail, by applying them in a common setting. Their input requirements and usability are examined. Contacts with selected MPOs, COGs, Planning Commissions in the State of Washington reveal

that such methods will be useful in small urban areas considering the staff, expertise, and budget limitation available. Currently, these small urban areas use unproven heuristic methods. The use of methods described in the report will considerably help small urban areas to forecast travel demands using traffic ground counts and socio-economic data.

27649 **(PB—88-166905/XAB) Characteristics of urban-transportation demand: a handbook for transportation planners (2nd edition). Draft report.** Levinson, H.S. (Charles River Associates, Inc., Boston, MA (USA)). Apr 1986. 109p. (CRA—784.01). NTIS, PC A06/MF A01.

See also PB—293220.

This edition of the handbook presents a comprehensive set of updated and reorganized data on a wide variety of statistics related to urban-travel-demand characteristics. The handbook is designed to be used by transportation planners and analysts as a source of data to check the validity and reasonableness of local forecasts using either conventional or emerging planning/modeling techniques, or as a cross-check on the similarity of travel statistics from one locality to another. Another use of the handbook would be to examine how key statistics have changed over time and to transfer these changes from one area to another. For those planning to compare the recent information in the handbook to the same types of data in the first edition, a key that matches the tables between the handbooks is presented at the end of the introductory section.

27650 **(PB—88-168281/XAB) Public-transportation marketing-evaluation manual: techniques for data collection. Final report.** Everett, P.B.; Shoemaker, R.W.; Doscher, W.E. (Pennsylvania State Univ., University Park (USA). Davey Lab.). Oct 1987. 87p. NTIS, PC A05/MF A01.

The manual is written for the public transportation marketing manager and staff who deal with marketing functions and marketing evaluation on a daily basis. It covers data-collection techniques for evaluation of transit-marketing programs; the instruments used to collect needed information once an evaluation design has been determined. The focus of the manual is on evaluation of consumer information aids, although some limited information is also presented on evaluation of pricing-incentive programs and advertising programs. Each data-collection technique is described on a single page so that it can be easily copied from the manual, used in other situations, distributed, and updated. Each sheet names a technique, notes what it applies to, what it measures, and how it works. Advantages and disadvantages of each technique are also noted. Techniques discussed include direct ridership counts, focus groups, several kinds of surveys, trip-planning tests, incentive coupon use, tracking of information and complaint phone calls, and information-aid consumption and discard rates, among others.

27651 **(PB—88-169834/XAB) Synthesis of technology on bituminous surfacing materials for low-volume roads. Final report, 26 September 1985-26 December 1986.** Shook, J.F.; Shannon, M.C. (ARE, Inc., Riverdale, MD (USA)). Jul 1987. 254p. NTIS, PC A12/MF A01.

Because agency officials responsible for the management of low-volume roads work with limited budgets, guidelines for selecting the most-practical design, maintenance, and rehabilitation alternatives must be established. Bituminous surfacings provide a good, often low-cost surfacing for low-volume roads. These surfacings may consist of hot-mix asphalt concrete, cold bituminous plant mixes, mixed in-place cold mixes, surface treatments or chip seals, slurry seals, and, in some cases, recycled mixes. Recycling should be considered as a cost-effective alternative for rehabilitating distressed pavements. This synthesis report contains sufficient information on the above topics to assist engineers and administrators in the decision process of designing, constructing, and maintaining low-volume roads. The text is thoroughly referenced to identify sources of additional detailed information.

27652 **(PB—88-169842/XAB) Quantification of urban-freeway congestion and analysis of remedial measures. Final report, September 1985-October 1986.** Lindley, J.A. (Federal Highway Administration, McLean, VA (USA). Traffic Systems Div.). Oct 1986. 37p. (FHWA/RD—87/052). NTIS, PC A03/MF A01.

This report presents an estimate of existing (1984) and future (2005) levels of congestion on the Nation's urban freeways based on data contained in FHWA's Highway Performance Monitoring System (HPMS) database. Estimates of congested travel, delay due to recurring congestion, delay due to non-recurring (incident) congestion, and wasted fuel are made on a national basis. Estimates of the aggregate impacts of several techniques for reducing freeway congestion, such as widening, surveillance and control systems, low-cost geometric improvements, and demand-reduction strategies are also made.

27653 **(PB—88-170444/XAB) Transit safety: a case study of New York State's Public Transportation Safety Board. Final report.** List, G.; Hagen, L.; Liang, J.C. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Civil Engineering). Nov 1987. 130p. NTIS, PC A07/MF A01.

The report presents a case study analysis of New York State's Public Transportation Safety Board (PTSB). It reviews the three-year-old organization in terms of its accomplishments in accident investigation, development of system safety plan guidelines, review of carrier-system safety plans, safety audits, and policy development. It also presents an analysis of the way in which PTSB interacts with the carriers it monitors; examines PTSB's relationship with other safety-related organizations at local, state, and national level; and compares PTSB with the transit safety agencies in other states. Finally, it examines three issues that are of more general interest: safety training, safety audits, and the need for independence for state-level safety-oversight agencies.

27654 **(PB—88-170774/XAB) Barriers to private-sector participation in public transportation. Final report.** Thompson, T.A. (New York State Dept. of Transportation, Albany (USA)). Sep 1986. 160p. NTIS, PC A08/MF A01.

Chapter One considers the full range of public-transportation services the private sector could provide looking at current U.S. examples. Chapter Two describes the Federal, state, and local barriers currently limiting private-sector provision of these services. Chapter Three summarizes the unique contribution of this study: an analysis of three New York counties utilizing private operators to provide varying percentages of public transportation under different institutional structures. The full case studies of the three New York counties - Onondaga (Syracuse), Suffolk (eastern Long Island), and Westchester (New York City suburb) - are presented in Appendices A-C. Appendices D and E exemplify purchase of service contracts currently in New York.

27655 **(PB—88-858659/XAB) Materials handling by slurry pipelines. August 1980-March 1986 (citations from the Engineering Index data base). Report for August 1980-March 1986.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 196p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the utilization of slurry pipelines for transporting metallic and nonmetallic minerals, and concentrates. Topics include system design, fluid dynamics analyses of a variety of suspensions, mathematical flow models, and equipment descriptions. Material abrasion and wear, economic aspects, and heat-transfer analyses are also discussed. Considerable attention is given to coal mixtures. (This updated bibliography contains 301 citations, none of which are new entries to the previous edition.)

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 27445, 27467, 27493, 27581, 27666, 27667, 28219

27656 **(MRT-81-D—0029) Use of non-azeotropic mixtures in thermodynamic cycles.** Rojey, A.;Berrada, N.;Marvillet, C. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). Jun 1985. 102p. (In French). NTIS (US Sales Only), PC A06;3. Order Number DE88752593/JAW.

The aim of the study is the valorization of low temperature heat to produce mechanical energy by expanding the working fluid in a turbine. The use of non-azeotropic mixture increases efficiency and more generally to optimize fluid properties and conditions of

utilization. Results of tests with ebullition and condensation of refrigerant R22 and R114 and also with the non-azeotropic boiling mixture R13/R22 are reported. Heat transfer and pressure drop are studied.

27657 **(PB—88-147970/XAB) Inventory of waste-to-energy facilities in Illinois.** Davlin, M. (Great Lakes Regional Biomass Energy Program, Madison, WI (USA)). Dec 1987. 45p. NTIS, PC A03/MF A01.

This report is a compilation of information on known waste-to-energy facilities that are: (1) under construction, (2) operating, or (3) shut down. The report is organized in separate sections for industrial, municipal solid waste, and hospital waste energy recovery installations. An index of facilities by location (county) is included.

27658 **(PB—88-153424/XAB) Enhanced energy recovery from the exhaust gases of basic oxygen furnaces through operation at pressure.** Shenoy, N.S.; Wilson, D.G. (Massachusetts Inst. of Tech., Cambridge (USA). Technology and Development Program). Jul 1985. 100p. (TDP—85-6). NTIS, PC A05/MF A01.

This theoretical preliminary-design study indicates that it is potentially possible to produce about 14 MW of net power from the exhaust gases of three small basic oxygen furnaces in the Helwan plant of the Egyptian Iron and Steel Company, Egypt. The turbine exhaust gases would flow through one or more rotary ceramic heat exchangers, incorporating a neutral-gas purge stage, heating pressurized oxygen for the lances. The gases would then pass on to a waste-heat boiler, a cooler, and probably a water wash before being ducted to the gas mains for use in the plant.

27659 **(PB—88-158795/XAB) Occurrence of transient puffs in a rotary-kiln incinerator simulator. 2. Contained liquid wastes on sorbent.** Linak, W.P.; McSorley, J.A.; Wendt, J.O.L.; Dunn, J.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1987. 12p. (EPA—600/J-87/166). NTIS, PC A03/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 37, No. 8, 934-942(Aug 1987); See also PB—87-179743.

The paper gives results of a study of the generation of transient puffs resulting from the batch incineration of liquid waste into a 73-kW rotary-kiln incinerator simulator. The liquid was added onto a sorbent, enclosed in cardboard cylinders that are introduced into the combustion chamber one at a time. A statistically designed parametric investigation determined the effects of liquid mass, liquid composition, kiln temperature, and kiln rotation speed on the total magnitude and instantaneous intensity of the pollutant puff leaving the kiln. Liquid wastes investigated included toluene, methylene chloride, carbon tetrachloride, and No. 5 fuel oil. Transient puffs from these wastes were monitored using on-line measurements for FID-measurable hydrocarbons, CO, and integrated particulate filter loadings, although the suitability of any one of these indicators depended on the chemical nature of the waste involved.

27660 **(PB—88-158985/XAB) Demetallation of used oil to facilitate its utilization as a fuel.** Kang, J.H.; Tarrer, A.R.; Kaminski, J.; Parrish, J.; Bates, E.R. (Auburn Univ., AL (USA)). Jan 1988. 50p. NTIS, PC A03/MF A01.

In the work, a chemical demetallation agent was used to convert entrained nonfilterable metals into a form which could be effectively removed by filtration. Two different types of chemical demetallation agents were used: metallic borohydrides ($NaBH_4$ and KBH_4) and diammonium phosphate (DAP). Several types of used oils having different metal contents were examined. It was observed that metallic borohydrides were highly selective with regard to the types of metals they removed and the accompanying sludge formed made the separation operation inefficient. On the other hand, results obtained with DAP were extremely favorable. The presence of water during the reaction was found to play an important role as a carrier for the DAP. The study also found the use of both sedimentation and filtration separation techniques to be practical, with filtration rates being significantly accelerated by the addition of low percentages of No. 2 fuel oil.

27661 **(PB—88-159710/XAB) Destruction of volatile organic compounds via catalytic incineration (journal version).** Palazzolo, M.A.; Tichenor, B.A. (Radian Corp., Research Triangle Park, NC (USA)). 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Environmental Progress, Vol. 6, No. 3, 172-176(Aug 1987); See also PB—86-119062.

This paper gives results of an investigation of the effect of catalytic incinerator design and operation on the destruction of specific volatile organic compounds (VOCs), both singly and in mixtures. A range of operating and design parameters were tested on a wide variety of compounds and compound mixtures. Conclusions of the study, presented here as applying only to the test catalyst and ranges of conditions tested, include: (1) VOC destruction efficiency increases with increasing temperature and concentration, and with decreasing space velocity; (2) the destructibility of VOCs varies according to compound class; (3) individual VOCs have different destruction efficiencies (at a given concentration, temperature, and space velocity); and (4) different destruction efficiencies may be obtained for a specific VOC incinerated in a mixture vs. burned alone.

27662 **(PB—88-160395/XAB) Energy-efficient concept for grinding rocks and ores. Phase 1 final report.** Mahyera, A. (Terra Tek, Inc., Salt Lake City, UT (USA)). May 1985. 49p. (TR—85-119). NTIS, PC A03/MF A01.

The objective of the research was to evaluate the feasibility of a simple and novel alternative method to grind ores and other materials at potentially very low cost in terms of energy and mineral consumption. The approach involved loading a water-filled vessel with the product normally fed into a tumbling mill; the pressurizing and releasing the confining fluid according to a pre-determined waveform. The principal findings are that: the concept is viable; the energy-efficiency of the process is of the order of 6 to 33 times higher than that of a conventional tumbling mill; the process could be scaled up to achieve throughout rates (in terms of tons/hour processed) competitive with current processing mills. The implications of the research are that the novel process has the potential to bring about major savings of national energy and mineral resources.

27663 **(PB—88-161575/XAB) Waste minimization in the printed circuit board industry: case studies.** Nunno, T.; Palmer, S.; Arienti, M.; Breton, M. (Alliance Technologies Corp., Bedford, MA (USA)). Jan 1988. 174p. NTIS, PC A08/MF A01.

This report presents information on waste-minimization practices currently employed in the printed circuit board (PCB) and semiconductor manufacturing industries. Case studies conducted at six facilities evaluated the technical, environmental, and cost impacts associated with the implementation of technologies for reducing the volume and toxicity of PCB metals-containing sludges and solvent wastes. The analyses of these data are the basis for demonstrating waste-minimization technologies to reduce hazardous waste.

27664 **(PB—88-858667/XAB) Materials handling by slurry pipelines. April 1986-February 1988 (citations from the Engineering Index data base). Report for April 1986-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 42p. NTIS PC N01/MF N01.

Supersedes PB—86-861424.

This bibliography contains citations concerning the utilization of slurry pipelines for transporting metallic and nonmetallic minerals, and concentrates. Topics include system design, fluid-dynamics analyses of a variety of suspensions, mathematical flow models, and equipment descriptions. Material abrasion and wear, economic aspects, and heat-transfer analyses are also discussed. Considerable attention is given to coal mixtures. (This updated bibliography contains 96 citations, all of which are new entries to the previous edition.)

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 27657, 27978, 28161, 28220

27665 (PB—88-160304/XAB) Cleaning of municipal-waste incinerator flue gas in Europe. Brna, T.G.; Ellison, W.; Jorgensen, C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jan 1988. 28p. (EPA—600/D-88/015). NTIS, PC A03/MF A01.

This paper gives an overview of a substantial ongoing air-pollution-control program in West Germany, as it relates to emission of acid gases and other pollutants from municipal-refuse incineration. It details emission regulations, control means used, and technical advancements accomplished and foreseen. It gives results and the approximate effectiveness of various controls in reducing acid gas, trace organic, trace heavy metal, and particulate-matter emissions. Available data indicate that lime spray dryer/electrostatic precipitator (ESP) and spray-dryer/fabric-filter systems can attain 70-90% acid-gas removal and 97% or more control of dioxins and furans, while limiting mercury emissions to about 0.01-0.07 mg/N-cu m (dry). In comparison, some wet-scrubber systems can attain 90-plus % acid-gas removal with substantial removal of NOx and comparable control of dioxins and furans, while possibly providing consistently lower mercury emissions.

27666 (PB—88-171723/XAB) Mitsubishi Juko Giho, Vol. 24, No. 6, 1987. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1987. 120p. NTIS, PC E05.

Text in Japanese with English abstracts. See also PB—88-171731, PB—88-171749 and PB—88-143219.

Table of Contents include: Development of full automatic control system of refuse incineration plant; Municipal refuse incineration plant for ministry of the enviornment, Singapore (illustration); Recent improvement on flue-gas treatment technology for municipal refuse incinerator; Features and operating experience of magnesium hydroxide process for flue-gas precipitator (EP) for blast-furnace top-pressure recovery turbine (illustration); Electrostatic precipitator with new energization system; Development of sewage-sludge incineration - Kasai Sewage Treatment Facility in Tokyo (illustration); Prediction of cooling-tower exhaust-gas diffusion at a geothermal power station; Internal fluid motion and dynamics of roll partially filled with liquid; Vibration of piping system by pulsation of containing fluid; Electrolytic polishing for niobium superconducting cavity; Development of high-speed line in liquid for continuous pickling line; Mitsubishi new small-size passenger car Mirage (illustration); New passenger car Galant (illustration); Study on earthquake-resistant design of multipod stack; Study of artificial dirt for rinsing appraisement in bottle; Development of intelligent-motion planning systems for robots; Automatic warehouse for steel wired-coil; Mitsubishi full hydraulic crawler drill MCD9G controlled by microcomputer; Mitsubishi catalytic combustion system.

27667 (PB—88-860309/XAB) Cogeneration: economic and technical analysis. August 1983-March 1988 (Citations from the NTIS data base). Report for August 1983-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 165p. NTIS PC N01/MF N01.

Supersedes PB—86-871449.

This bibliography contains citations concerning economic and technical analysis of cogeneration systems. Topics include electric power and steam generation, dual-purpose and fuel cell power plants, and on-site power generation. Tower focus power plants, solar cogeneration, biomass conversion, coal liquefaction and gasification, and refuse-derived fuels are discussed. Feasibility studies, performance and economic evaluation, environmental impacts, and institutional factors are included. (This updated bibliography contains 314 citations, 17 of which are new entries to the previous edition.)

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 27448, 27453, 27545, 27682, 27684

27668 (PB—88-159884/XAB) Study of the effects of reduced diesel-fuel sulfur content on engine wear. Final report, September 1986-June 1987. Frame, E.A.; Alvarez, R.A.; Sefer, N.R. (Southwest Research Inst., San Antonio, TX (USA)). Jun 1987. 92p. NTIS, PC A05/MF A01.

This study evaluated wear in heavy-duty highway-type engines for reduction of sulfur content of diesel fuel in the range of 0.50 to 0.05 wt.%. A literature review found that wear rates generally were reduced by decreasing fuel sulfur content. The amount of wear reduction was affected as much by operating temperature and engine load as by sulfur in the fuel. Low operating temperatures showed more wear at high sulfur levels and, therefore, more benefit for low sulfur fuels. Increasing engine load caused higher wear rates independent of sulfur content.

27669 (PB—88-162946/XAB) Enhanced marine diesel-engine performance and component durability towboat field test and evaluation (thin ceramic coatings and plateau-honed silicon carbide impregnated liners). Technical report (Final), August 1984-January 1987. Winkler, M.F.; Vollemans, P.J.; Shumski, G.J.; Cass, R.W. (Seaworthy Systems, Inc., Essex, CT (USA)). Nov 1987. 251p. NTIS, PC A12/MF A01.

This report presents the test and evaluation results of thin ceramic-coated combustion components and plateau-honed silicon carbide impregnated cylinder liners as installed in an inland-river towboat diesel engine covering a total of approximately 14,000 running hours. An 8-cylinder starboard engine was instrumented. Data were collected automatically by a computer-driven data-acquisition system. In addition to automatic data collecting, five (5) closely controlled tests were performed over the normal operating range of the engine. Prior to these tests, boroscopic inspections were done to assess the condition of the ceramic coatings and treated liners. Electronic combustion analyses were performed simultaneously with each closely controlled test. The test and evaluation resulted in an 11% reduction in specific fuel consumption. Mechanical and thermal efficiencies showed an average improvement of 10, 5% respectively, and maximum horsepower was 18% higher. After 14,000 running hours, the zirconia-based thermal-barrier ceramic-coated components were inspected and found to be in good condition and capable of more service while the silicon-carbide impregnated liners were scuffed and unsuitable for further service.

27670 (PB—88-170089/XAB) Mouse skin tumors as a predictor of human lung cancer for complex emissions: an overview. Nesnow, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Feb 1988. 34p. (EPA—600/D-88/025). NTIS, PC A03/MF A01.

In the late 1970's, the U.S. Environmental Protection Agency assessed the impact of the diesel-powered passenger automobile on the current fleet of gasoline powerplants. Little was known regarding the toxicological effects of exposure to diesel emissions, the components of diesel exhaust, or their physical characteristics. Although a number of epidemiological studies had been completed, none showed a causal relationship between exposure to diesel exhaust and an increased incidence in lung cancer. There were no well-conducted studies in experimental animals which indicated a cancer hazard by any route of administration. A broad-range research program was initiated to study the mutagenic and carcinogenic effects of diesel engine emissions and other related complex-mixture samples. These studies featured a combined approach of analytical chemistry, genetic toxicity bioassay, and tumor bioassay to fully characterize both the complex mixtures themselves as well as individual components which might be responsible for biological activities. This paper summarizes the approaches taken and the results obtained and cities previously published data. Also pre-

sented are some current research efforts aimed at furthering our knowledge of these relationships.

27671 Acoustic cooling engine. Hofler, T.J.; Wheatley, J.C.; Swift, G.W.; Migliori, A. (to Dept. of Energy, Washington, DC). US Patent 4,722,201. 2 Feb 1988. Filed date 16 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

An acoustic cooling engine is described comprising: container means for containing a compressible fluid which is capable of supporting and acoustic standing wave having a selected wavelength, the container means having two ends defining a length about half the wavelength of the acoustic standing wave; driver means for cyclically driving the compressible fluid at a frequency corresponding to the selected wavelength, the driver means being positioned at one of the ends of the container means, the one end being a location of maximum acoustical impedance; a thermodynamic element located in the container means and having a first end proximate to the driver means and a second end located further away from the driver means than the first end and defining a length less than one-fourth the wavelength of the acoustic standing wave, the thermodynamic element being thermally responsive to the acoustic standing wave to cause heat to be pumped from the second end to the first end thereby thermally isolating the second end from the driver means; and conductor means for conducting heat away from the first end of the thermodynamic element.

27672 Sector airflow variable geometry combustor. Hudson, D.A.; Hopkins, K.N. (to Secretary of the Air Force, Washington, DC). US Patent 4,720,970. 12 Jan 1988. Filed date 5 Nov 1982. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A combustor is described comprising: a. annularly disposed fuel nozzles for supplying fuel for combustion; b. means defining annularly-shaped combustion zone near the fuel nozzles; c. means defining an annularly-shaped air plenum surrounding the fuel nozzles and having openings near the fuel nozzles for supplying air of fuel combustion in the combustion zone; d. wall means separating a predetermined angular sector of the annular air plenum from the remainder thereof, the angular sector including a predetermined portion of fuel nozzles, whereby the airflow within the plenum to the predetermined portion of the fuel nozzles is isolated from the airflow to the remaining fuel nozzles of the combustor not within the sector; and e. valve means for controlling the flow of air only through the sector.

27673 Regenerator cross arm seal assembly. Jackman, A.V. (to Dept. of Energy, Washington, DC). US Patent 4,720,969. 12 Jan 1988. Filed date 15 Oct 1981. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In a gas turbine engine having block means defining a pressurized air passage and a hot exhaust gas passage and a cross arm partition separating portions of the air and the exhaust passages, a regenerator disc on the block means intersecting the air and the exhaust passages and rotatable to transfer heat from the exhaust gas to the pressurized air and including an inboard surface, and rim seal means between the disc inboard surface and the block means operative to prevent pressurized air and exhaust gas leakage around the periphery of the disc, an improved cross arm seal assembly is described comprising: a platform generally extensive with the cross arm partition disposed between the latter and the disc inboard surface, a porous and compliant support layer on a surface of the platform facing the disc inboard surface, a seal and wear layer on the support layer defining a barrier to gas passage and sealingly engaging the disc inboard surface, dike means between the seal and wear layer and the platform preventing communication through the support layer between the air and the exhaust passages, seal means between the platform and the cross arm partition preventing communication between the air and the exhaust passages across the cross arm partition, and means on the block means and on the platform operative to direct air from the pressurized air passage to and through the support layer thereby to cool the seal and wear layer.

27674 Progress on the investigation of coal water slurry fuel combustion in a medium speed diesel engine: Part 1. Ignition studies. Hsu, B.D. New York, NY; American Society of Mechanical Engineers (1988). 10p. (CONF-880104—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

Technical Paper 88-ICE-4.

A micronized de-ashed coal-water slurry (CWS) fuel of approximately 50% coal loading has been successfully ignited and burned in one GE 7FDL engine cylinder at 1050 rpm. For this study, only about one-third of the full load fuel energy was supplied due to limitations of the fuel injection equipment used. Three types of ignition methods have been investigated. They were: Compression ignition with no ignition aid; Separate deisel pilot fuel injection to ignite the CWS fuel; Combined CWS and pilot diesel fuel injection (stratified pilot ignition). Conditions of ignition and the burning characteristics that immediately followed using the above three ignition methods are described.

27675 Progress on the investigation of coal water slurry fuel combustion in a medium speed diesel engine: Part 2. Preliminary full load test. Hsu, B.D. New York, NY; American Society of Mechanical Engineers (1988). 10p. (CONF-880104—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

Technical Paper 88-ICE-5.

Full load (186 kW/cyl) operation using CWS fuel at 1050 rpm has been achieved on single cylinder GE-7FDL test engine. No major changes in engine parameters were made. With normal inlet air conditions, 3-5% pilot deisel fuel, separately injected or stratified into the main coal charge, was used. Inlet air temperature had to be raised about 40°C if no pilot diesel fuel was used. The coal burnout was about 95% and the cycle efficiency was comparable to using diesel fuel. The NO/sub x/ and CO emissions were about 1/2 of those obtained normally with deisel fuel. The maximum heat release rate was higher than diesel fuel operation which resulted in higher maximum cylinder firing pressure. The combustion characteristic and its dependence on some fuel characteristics and inlet air parameters are discussed. Increasing coal burnout while limiting maximum cylinder firing pressure is the main objective of near future studies.

27676 Durability of ceramic coatings in 14,000 hours service in a marine diesel engine. Levy, A.V.; Macadam, S. New York, NY; American Society of Mechanical Engineers (1988). 8p. (CONF-880104—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

Technical Paper 88-ICE-19.

A representative selection of diesel engine combustion zone components coated with plasma sprayed zirconia thermal barrier systems was analyzed after 14,000 hours of practical engine service. The analysis consisted of determining the degree of success of the different coating systems and suggesting probable mechanisms of failure. The coating systems under investigation include a flame stabilized and a pre-alloyed 8% Y/sub 2/O/sub 3/-ZrO/sub 2/, and a flame stabilized 22% MgO-ZrO/sub 2/. All three of these systems applied to piston crowns survived engine service with no noticeable deterioration of any kind. Coating performance on valve faces was mixed. The 22% MgO-ZrO/sub 2/ valve coating consistently spalled at or near the interface with the bond coat. This failure was due to the volume expansion associated with the observed phase transformation of the zirconia to the monoclinic structure. The flame stabilized 8% Y/sub 2/O/sub 3/-ZrO/sub 2/ on the valves consistently failed over large regions while the pre-alloyed coating of the same composition survived with only minimal loss. The performance pattern of all three systems after 14,000 hours closely resembled their performance determined during a similar study at the conclusion of 9000 hours engine service. This strongly suggests that the successful coating system-engine component combinations indi-

cated have the durability to reliably serve through the overhaul lifetime in this type of service (18,000 to 22,000 hours).

27677 **Coal-water slurry operation in an EMD diesel engine.** Urban, C.M.; Mecredy, H.E.; Ryan, T.W. III; Ingalls, M.N. New York, NY; American Society of Mechanical Engineers (1988). 8p. (CONF-880104—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

Technical Paper 88-ICE-28.

The U.S. Department of Energy, Morgantown Energy Technology Center has assumed a leadership role in the development of coal-burning diesel engines. The motivation for this work is obvious when one considers the magnitude of the domestic reserves of coal and the wide-spread use of diesel engines. The work reported in this paper represents the preliminary engine experiments leading to the development of a coal-burning, medium-speed diesel engine. The basis of this development effort is a two-stroke, 900 rpm, 216-mm (8.5-inch) bore engine manufactured by Electro-Motive Division of General Motors Corporation. The engine, in a minimally modified form, has been operated for several hours on a slurry of 50 percent (by mass) coal in water. Engine operation was achieved in this configuration using a pilot injection of diesel fuel to ignite the main charge of slurry. A standard unit injector, slightly modified by increasing diametrical clearances in the injector pump and nozzle tip, was used to inject the slurry. Under the engine operating conditions evaluated, the combustion efficiency of the coal and the NO/sub x/ emissions were lower than, and the particulate emissions were higher than, corresponding diesel fuel results. These initial results, achieved without optimizing the system on the coal slurry, demonstrate the potential for utilizing coal slurry fuels.

27678 **Experiments with coal fuels in a high temperature diesel engine.** Likos, W.E.; Ryan, T.W. III. New York, NY; American Society of Mechanical Engineers (1988). 10p. (CONF-880104—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

Technical Paper 88-ICE-29.

The combustion of 50 wt% coal slurries, using water, diesel fuel, and methanol as carrier liquids, was investigated in a single-cylinder research engine. High temperatures were achieved in the engine cylinder using low-heat rejection engine technology, electrically heated glow plugs, and heated inlet air. Comparisons of the fuels and different methods of providing high cylinder temperature were made using cylinder pressure data and heat release calculations. Autoignition of the coal/water slurries was attained using auxiliary heat input. The burning rates of all the autoignited slurries were significantly enhanced by using a pilot injection of diesel fuel. Under some operating conditions the engine thermal efficiency was equal to diesel fuel performance. It was apparent that engines designed for coal slurry should maximize the prechamber volume.

27679 **Design, calibration and error analysis of instrumentation for heat transfer measurements in internal combustion engines.** Ferguson, C.R.; Tree, D.R.; De Witt, D.P.; Wahiduzzaman, S.A.H. (School of Mechanical Engineering, Purdue Univ., West Lafayette, IN (USA)). pp 67-82 of Developments in experimental techniques in heat transfer and combustion. Warrington, R.O.; Chen, M.M.; Felske, J.D.; Grosshandler, W.L. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Methodology and uncertainty analysis are presented for determining (1) local wall heat flux in an internal combustion engine using a surface thermocouple type heat flux gage and (2) apparent flame temperature and soot volume fraction path length product in a diesel engine using two-color pyrometry.

3303 Electric-powered Systems

27680 **(EUR—10287) Study and realization of a system for transformation of energy from a rectilinear engine to a variable speed circular motion.** (Commission of the European Communities, Luxembourg). 1986. 87p. (In French). NTIS (US Sales Only), PC A05/MF A01;1. Order Number DE88752596/JAW.

The aim of the study is the realization and testing, first on a stand, then on an independent mobile platform, of a kinematic system comprising: (1) a rectilinear internal combustion engine. This engine is characterized by a high thermodynamic efficiency and direct transformation of thermal energy into electric energy without crank and connecting rod, (2) variable reluctance electric motors placed inside the leader wheels. These motors are characterized by a high torque and speed adjustment, (3) electronic devices for control. A global efficiency of 26% was obtained although below forecasted value it could be increased.

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 27676

3307 Emission Control

REFER ALSO TO CITATION(S) 27453, 27670, 28129

27681 **(PB—88-159843/XAB) Effects of gasoline volatility on the hydrocarbon exhaust emissions from a 1984 Oldsmobile Cutlass. Technical report.** Schuler, A.E. (Environmental Protection Agency, Ann Arbor, MI (USA)). Aug 1987. 26p. (EPA/AA/SDSB—87/10). NTIS, PC A03/MF A01.

This report describes the results of a gasoline volatility/exhaust emission test program done under EPA contract by ATL Laboratories in Columbus, Ohio. The program was developed to help explain why hydrocarbon exhaust emissions frequently increase when using fuels with high volatility. The testing involved a 1984 3.8L Olds Cutlass with multi-point fuel injection. Two different fuels (9.0 and 11.5 psi RVP) were used, along with three different conditions of the evaporative canister (no purge, Standard canister loading, and a loading beyond breakthrough). In addition, tests were performed with both fuels with the catalytic converter removed and a standard canister loading to determine the effect of RVP on engine-out emissions.

27682 **(PB—88-168224/XAB) Diesel-particulate study. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA). Emission Control Technology Div.). Oct 1983. 294p. NTIS, PC A13/MF A01.

The purpose of the study is to provide a comprehensive assessment of the costs and environmental effects of the control of diesel-particulate emissions and to recommend a regulatory strategy for their control. As such, the study expands, updates and combines the regulatory analyses supporting the light-duty-diesel particulate final rule and the heavy-duty-diesel particulate proposed rule. The study identifies current and future diesel-particulate emissions and exposure levels, assess the health and welfare impact of diesel particulate, and estimate the costs of controlling diesel-particulate emissions to various levels. The study also integrates these aspects of diesel-particulate control and will develop, evaluate, and recommend a regulatory control strategy.

27683 **(PB—88-169594/XAB) Guidance on estimating motor-vehicle emission reductions from the use of alternative fuels and fuel blends. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA). Emission Control Technology Div.). 29 Jan 1988. 87p. (EPA/AA/TSS/PA—87/4). NTIS, PC A05/MF A01.

The document provides methods and assumptions for estimating the impact of use of alternative fuels and fuel blends on motor-vehicle emissions including HC, CO, and NOx. The information is presented in a format which assumes it will be used by State

and local air-quality planning agencies in preparing current and future emissions inventories and emission-reduction strategies during 1988, 1989, and 1990. Such planning efforts will be necessary in areas which receive calls from EPA for revisions to their ozone or CO State Implementation Plans (SIP) following their failure to attain (or in a few cases following their failure to provide for attainment in a prospective sense) the National Ambient Air Quality Standards (NAAQS) for these pollutants. EPA has recently proposed requirements applicable to these SIP calls (52 FR 45044, November 24, 1987), and many affected areas will need to estimate current- and future-year motor-vehicle emissions. Use of alternative fuels and fuel blends is likely to be part of future scenarios that will be examined in many areas.

27684 (PB—88-169891/XAB) Heavy-duty-engine testing report - correlation testing of Isuzu 5.79L/JAMA engine. Technical report. Baines, T.M. (Environmental Protection Agency, Ann Arbor, MI (USA)). Dec 1987. 54p. (EPA/AA/SDSB—88/01). NTIS, PC A04/MF A01.

Supersedes PB—87-234548.

The report describes the results of testing an Isuzu 5.79-L heavy-duty engine at the Environmental Protection Agency Motor Vehicle Emission Laboratory. The correlation between the heavy-duty test facilities of a manufacturer and EPA is important in that relatively new transient heavy-duty engine-testing procedures have been implemented. The testing was conducted to provide such correlation data for comparison with similar data developed by four Japanese Automobile Manufacturers Association (JAMA) member companies. Included in the report are descriptions of the engine, fuel, test procedures, and test plans.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 27674, 27675, 27678, 27683

27685 (AD-A—188330/5/XAB) 1984 CRC (Coordinating Research Council) intermediate temperature driveability program using gasoline-alcohol blends. (Coordinating Research Council, Inc., Atlanta, GA (USA)). Aug 1987. 115p. (CRC—554). NTIS, PC A06/MF A01.

Thirty 1984 and six 1979 model-year vehicles were tested with two hydrocarbon-only fuels and twenty hydrocarbon-alcohol blends during October and November 1984 at Paso Robles, California, to identify the effect of alcohol type, alcohol concentration, cosolvent type and methanol to cosolvent ratio on cold-start and warmup driveability at intermediate temperature (40 F-60 F). The secondary objective of the program was to determine if the 10, 50, and 90% distillation temperatures of these test fuels could predict cold-start and warmup driveability performance. In general, the hydrocarbon-only fuels gave better driveability than the hydrocarbon-alcohol blends; however, the 1984 model vehicles had better driveability on all fuels than earlier programs had exhibited. Fuel-injected vehicles gave better driveability than carburetted vehicles with all fuels. Increased volatility improved driveability with both hydrocarbon-only fuels and hydrocarbon-alcohol blends. Gasoline-ethanol blends gave better driveability than gasoline-methanol (without a cosolvent) blends. No significant differences were observed when ethanol and gasoline-grade tertiary butyl alcohol were compared as cosolvents in methanol blends.

27686 (PB—88-161278/XAB) Durability of low-cost catalysts for methanol-fueled vehicles. Technical report. Heavenrich, R.M.; Bruetsch, R.I.; Piotrowski, G.K. (Environmental Protection Agency, Ann Arbor, MI (USA)). Oct 1987. 34p. (EPA/AA/CTAB—87/01). NTIS, PC A03/MF A01.

This report describes the durability of low cost catalytic converters operated on methanol-fueled vehicles in fleet service. The catalysts were first tested at EPA for efficiency at zero miles and then aged 12,000-14,000 mile in Los Angeles, California as part of a California Energy Commission sponsored program in cooperation with Ford, Toyota, and EPA. The report also compares Federal Test Procedure and Highway Test results at the 12,000- and 14,000-mile point with the zero-mileage results.

35 ARMS CONTROL

27687 (PB—88-858972/XAB) Strategic defense and arms control. January 1970-February 1988 (Citations from the NTIS data base). Report for January 1970-February 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 54p. NTIS PC N01/MF N01.

This bibliography contains citations concerning studies of relationships between national defense needs and arms-control policies. Included are references to specific weapons systems and initiatives, such as the cruise missile, MX missile, Trident, non-nuclear strategic weapons, and chemical weapons; and strategies involving space, NATO, and the Strategic Defense Initiative. Policies, positions, and negotiations refer to the Strategic Arms Limitation Talks (SALT), the Strategic Arms Reduction Talks (START), the Anti-ballistic Missile Treaty, and international meetings on proliferation of weapons, and on space for military missions. (Contains 105 citations fully indexed and including a title list.)

3501 Policy, Negotiations, And Legislation

REFER ALSO TO CITATION(S) 28096, 28097

27688 (AD-A—188565/6/XAB) Soviet objectives in the INF negotiations and European security. Master's thesis. Baumgardner, H.J. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1987. 80p. NTIS, PC A05/MF A01.

On 12 December 1979, NATO officials announced the decision to deploy 108 Pershing II nuclear missiles and 464 Ground Launched Cruise Missiles, in response to the Soviet deployment of SS-20 nuclear missiles. The NATO decision was met by a determined Soviet effort to prevent the deployment of the new missiles. The Soviet effort consisted of negotiations, diplomatic propaganda, and covert measures. When it was clear that the deployment was not going to be stopped, the Soviets agreed to formal INF arms-reduction talks. It is this author's opinion that the Soviet negotiation tactics, during the INF talks, supported the long-range goal of reducing the military effectiveness of NATO, and also supported the goal of reducing U.S. influence in Europe.

27689 (AD-A—188892/4/XAB) Strategic context for assessing long-range offense and active defense. Technical report, 16 October 1985-27 October 1986. (Pan Heuristics, Los Angeles, CA (USA)). 27 Oct 1986. 66p. NTIS, PC A04/MF A01.

This technical report discusses the relation between systems for attack and systems for active defense, assesses various courses of action, and identifies critical technologies. It warns against certain forms of arms agreements, and points out of the paralyzing effects of a belief in mutual assured destruction. It also discusses the consequences of nuclear proliferation.

27690 (PB—88-162045/XAB) Reykjavik and beyond: deep reductions in strategic nuclear arsenals and the future direction of arms control. (National Academy of Sciences, Washington, DC (USA)). 1988. 82p. NTIS, PC A05/MF A01.

Library of Congress catalog card No. 87-30193.

In the spring of 1987, members of the National Academy of Sciences Committee on International Security and Arms Control presented a seminar for the Academy audience to explore the implications of the proposals for very deep cuts in strategic nuclear arsenals that had been discussed by President Reagan and General Secretary Gorbachev at the Reykjavik summit in 1986. The collection of seminar talks by scientific, military, and political experts explores the meaning of 50% or greater cuts in the superpower strategic nuclear arsenals and how very deep cuts would affect other aspects of the military balance and the political and international order more broadly. Individually authored chapters discuss the purpose and effect of deep strategic force reductions, the impact of defenses and of new technologies and non-central systems on offensive reduction regimes, and the political and military implications for Europe of deep cuts in the superpower strategic arsenals.

3502 Proliferation

REFER ALSO TO CITATION(S) 27689, 28100

36 MATERIALS

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 27477, 27538, 27582, 27752, 27923, 28006, 28177, 28362, 28769, 28770

27691 (AD-A—187953/5/XAB) Al and Mg alloys for aerospace applications using rapid solidification and powder-metallurgy processing. Annual technical report No. 2. Fraser, H.L. (Illinois Univ., Urbana (USA). Dept. of Materials Science and Engineering). 7 Oct 1981. 89p. NTIS, PC A05/MF A01.

This report covers the progress made in the second year of a three-year study on the application of rapid solidification processing (RSP) to A1 and Mg alloys. The main emphasis of this study has been on the understanding of the microstructures produced by rapid solidification. The alloy systems studies include: 1) A1 alloys for elevated temperature applications, namely A1-8Fe-2Mo with additions of Si, and 2) Mg alloys for elevated temperature applications, namely, Mg-Gd,Mg-Li,Mg-Li-Si.

27692 (AD-A—188290/1/XAB) Visible-laser etching of refractory metals by surface modification. Rothchild, M.; Sedlacek, J.H.; Ehrlich, D.J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Oct 1987. 5p. (JA—5994). NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science and Technology B, Vol. 5, No. 5, 1400-1403(Sep/Oct 1987).

A two-step laser etching technique for Mo and W films is described. In the first step, the laser modifies the chemical composition of the metal surface; in the second, deep etching of the pre-exposed areas is by broad-area heating in a reactive ambient. The surface modification takes place in the presence of C/2, which etches the native-metal oxide and replaces it with a more volatile metal halide. Deep etching is performed with NF_3. Since the native oxide is resistant toward etching with NF_3, the second step is selective with respect to the laser-halogenated area and is, in effect, a chemical amplification of the surface modification. Well-delineated, high-contrast patterns are obtained with this method.

27693 (AD-A—188508/6/XAB) Hot corrosion in gas turbines: a new, unique and informative technique is EASE (Electronic Absorption Spectroscopy Experiments). Final report, 31 July 1984-1 December 1986. Griffiths, T.R. (Leeds Univ. (UK). Dept. of Inorganic and Structural Chemistry). 20 May 1987. 71p. NTIS, PC A04/MF A01.

The hot corrosion of advanced turbine materials used in aerospace applications may now be studied successfully with EASE (Electronic Absorption Spectroscopy Experiments). This technique permits the continuous monitoring of the dissolution of corrosion products into molten sulfate deposits under conditions that replicate effectively these developed for studying hot corrosion on superheater tubes, this preliminary study has developed and extended it to turbine materials, where the effects of thermal cycling and chloride addition can be followed. The report details the spectroscopic studies made and how rates are obtained from spectra; the design and testing of thermal-gradient furnaces; and some crucible and spectroscopic studies of IN 738 in sulfate + chloride melts. A recently marketed American Fiber optic spectrophotometer could be modified to enhance EASE studies and make in-situ studies of operating turbines.

27694 (AD-A—188682/9/XAB) Development of metastable processing paths for high-temperature alloys. Annual technical report, 9 February-30 September 1987. Boettinger, W.J. (National Bureau of Standards, Washington, DC (USA). Metallurgy Div.). 30 Sep 1987. 40p. NTIS, PC A03/MF A01.

The possibility of developing new processing strategies for high-temperature intermetallic compounds is being investigated. In particular, rapid solidification followed by controlled heat treatment may provide new and unusual microstructures of multiphase materials. This report describes research performed at NBS to develop predictive models for solubility extension and metastable phase formation of intermetallic compounds and research to improve the phase diagram modeling of systems involving ordered phases. Theory has been clarified to treat the interface shape stability for intermetallic compounds during solidification. Using modified variables to describe the phase diagram near an intermetallic compound the solidification conditions required to avoid microsegregation were obtained. Experimental research has been conducted on three intermetallic systems, Aluminum-niobium, Nickel aluminum-nickel titanium, and Titanium-aluminum to gain experimental data base for theoretical model development using melt spinning and examination by transmission electron microscopy.

27695 (AD-A—188710/8/XAB) High-strain deformation processing of Ni-W alloys. Leng, Y.; Courtney, T.H.; Malzahn Kampe, J.C. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1987. 10p. NTIS, PC A02/MF A01.

Pub. in Materials Science and Engineering, Vol. 94, 209-217(1987).

This paper discusses the potential of Ni-W alloys of differing initial microstructures, for high-strain cold-deformation processing, and thus their suitability for development as heavily deformed, high-strength in situ composites. Varying initial phase morphologies and tungsten volume fractions were produced by variations in initial processing. Liquid-phase sintered structures, containing 48 vol.% W, can be cold rolled to true strains of 2.4. They presumably could be cold worked further, but size limitations imposed by our processing capability prevented that being done in this study, Likewise, low volume fraction (of less than 15 vol.%) tungsten alloys, produced by casting of a hypoeutectic nickel-rich alloy and by transient liquid-phase sintered Ni-W structure. In contrast, as-cast arc melted alloys cannot be cold drawn to any extent at room temperature. They can not be made capable of limited drawability by subjecting them to a coarsening heat treatment, which also spheroidizes eutectic tungsten to some extent, prior to cold working.

27696 (AD-A—188972/4/XAB) Hydrogen embrittlement of gun steel. Final report. Spencer, G.L. (Army Armament Research and Development Command, Watervliet, NY (USA). Benet Weapons Lab.). Nov 1987. 803p. (ARCCB-TR—87030). NTIS, PC A99/MF E04.

Objectives of this engineering project were to determine the critical concentration of hydrogen at which gun steel is embrittled, and to evaluate the effects of some acid solutions on gun steel to determine safe exposure parameters.

27697 (GKSS—87/E/51) Extension of the engineering treatment model (ETM) to bending configurations under plane stress. Progress report on an investigation of the elastic-plastic-R-curve methodology. Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofforschung). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753235/JAW.

The application of the previously introduced Engineering Treatment Model to bending configurations involves the prediction of the crack tip opening displacement, the load line displacement, and the J-integral. Using these, failure situations can be predicted. All predictions except one are in good agreement with experimental results (Al2024-FC, Al2024-T351, steel 35Ni(rMo16, pressure vessel steel 20MnMoNi55) or finite element calculations. The reason for the exception is clear and will be utilised for an improvement of the model. With 26 figs., 2 tabs..

27698 (INIS-BR—1038) Spectrography analysis of stainless steel by the point to point technique. Bona, A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. 99p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702302/JAW.

A method for the determination of the elements Ni, Cr, Mn, Si, Mo, Nb, Cu, Co and V in stainless steel by emission spectrographic analysis using high voltage spark sources is presented. The 'point-to-point' technique is employed. The experimental parameters were optimized taking account a compromise between the detection sensitivity and the precision of the measurement. The parameters investigated were the high voltage capacitance, the inductance, the analytical and auxiliary gaps, the period of pre burn spark and the time of exposure. The edge shape of the counter electrodes and the type of polishing and diameter variation of the stailess steel electrodes were evaluated in preliminary assays. In addition the degradation of the chemical power of the developer was also investigated. Counter electrodes of graphite, copper, aluminium and iron were employed and the counter electrode itself was used as an internal standard. In the case of graphite counter electrodes the iron lines were employed as internal standard. The relative errors were the criteria for evaluation of these experiments. The National Bureau of Standards - Certified reference stainless steel standards and the Eletrometal Acos Finos S.A. samples (certified by the supplier) were employed for drawing in the calibration systems and analytical curves. The best results were obtained using the convencional graphite counter electrodes. The inaccuracy and the imprecision of the proposed method varied from 2% to 15% and from 1% to 9% respectively. This present technique was compared to others instrumental techniques such as inductively coupled plasma, X-ray fluorescence and neutron activation analysis. The advantages and disadvantages for each case were discussed.

27699 **(INIS-BR—1046) Peening as a stress relieving method for welded joints.** Ferreira, M.L.R. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1984. 109p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702310/JAW.

The efficacy of the process of stress relieving by hammer-peening, in heavy plates of low carbon steel is analysed. The effects of peening in the mechanical properties of welded metal deposited by shield metal arc welding, using the electrodes E-6010, E-7018 and E-8018C-2, and the weld metal deposited by submerged arc welding, using the filler metals ENil and EA3, are also analysed. X-ray diffraction was used in order to verify the efficacy of peening as a stress-relieving process. The obtained results and the literature reviewed show that, peening is effective in stress relieving.

27700 **(INIS-BR—1061) Development of Nb-Ti multifilamentar superconducting wires.** Otubo, J. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1986. 121p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702324/JAW.

Ni-Ti superconducting wires with multifilamentar configuration were produced, using the grouping technique. Some basic concepts on superconductivity and its main critical parameters are presented. The criteria for stabilizing superconductors in terms of the geometry are studied. The main critical parameters, H/sub c/, J/sub c/, T/sub c/ in function of the composition and the metallurgical structure of Ni-Ti alloy are analysed. The development of Ni-Ti superconducting wires is described. (M.C.K.).

27701 **(Juel—2126) Fracture mechanical studies on high temperature alloys between room temperature and 900/sup 0/C.** Kwasny, R.J.; Roedig, M.; Schubert, F.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Technische Hochschule Aachen (Germany, F.R.)). May 1987. 212p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753268/JAW.

Dissertation submitted by R.J. Kwasny.

As a contribution to the fracture mechanics characterization of the three solid-solution hardened alloys X10NiCrAlTi 32 20, NiCr 22 Co 12 Mo and NiCr 22 W 12 Si, (material No. 1.4876, No. 2.4663 and No. 2.4972) investigations of the J-integral concept in room temperature tests, of creep crack growth at 800 and 850/sup 0/C and of fatigue crack growth at 700-900/sup 0/C were carried out. Standard compact tension test pieces (1/2 inch and 1 inch) were used. In order to assess the transferability of crack growth relationships determined on standardized specimens to component geometries, fatigue crack growth tests were carried out on thick-walled tubes with external circumferential notches. The measurement of crack length was accomplished using the d. c. potential drop method which was further developed and optimized for these particular experimental conditions. The creep crack growth was described using the stress intensity (K/sub I/), the energy rate integral (C/sup */) and the net stress (σ/sub net/) concepts. For description (ΔK/sub I/) could be applied. Because no dependence of fatigue crack growth on either specimen size or on specimen geometry (CT specimen, tube specimen) was found, fatigue crack growth data determined on CT specimens are transferable to tubes with circumferential notches. (orig./IHOE).

27702 **(MR—202) Zirconium - an imported mineral commodity.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Oct 1983. 145p. (In English, French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702469/JAW.

This report examines Canada's position in regard to the principal zirconium materials: zircon; fusion-cast zirconium-bearing refractory products; zirconium-bearing chemicals; and zirconium metal, master alloys, and alloys. None of these is produced in Canada except fused alumina-zirconia and certain magnesium-zirconium alloys and zirconium-bearing steels. Most of the 3 000-4 000 tonnes of the various forms of zircon believed to be consumed in Canada each year is for foundry applications. Other minerals, notably chromite, olivine and silica sand are also used for these purposes and, if necessary, could be substituted for zircon. Zirconium's key role in Canada is in CANDU nuclear power reactors, where zirconium alloys are essential in the cladding for fuel bundles and in capital equipment such as pressure tubes, calandria tubes and reactivity control mechanisms. If zirconium alloys were to become unavailable, the Canadian nuclear power industry would collapse. As a contingency measure, Ontario Hydro maintains at least nine months' stocks of nuclear fuel bundles. Canada's vulnerability to short-term disruptions to supplies of nuclear fuel is diminished further by the availability of more expensive electricity from non-nuclear sources and, given time, from mothballed thermal plants. Zirconium minerals are present in many countries, notably Australia, the Republic of South Africa and the United States. Australia is Canada's principal source of zircon imports; South Africa is its sole source of baddeleyite. At this time, there are no shortages of either material. Canada has untapped zirconium resources in the Athabasca Oil Sands (zircon) and at Strange Lake along the ill-defined border between Quebec and Newfoundland (gittinsite). Adequate metal and alloy production facilities exist in France, Japan and the United States. No action by the federal government in regard to zirconium supplies is called for at this time.

27703 **Structure of icosahedral clusters in cubic Al/sub 5.6/Li/sub 2.9/Cu.** Guryan, C.A.; Stephens, P.W.; Goldman, A.I.; Gayle, F.W. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review [Section] B: Condensed Matter;* 37: No. 14, 8495-8498(15 May 1988).

We present a structure refinement of crystalline Al/sub 5.6/Li/sub 2.9/Cu based on x-ray and neutron diffraction data. We find that clusters of atoms form nearly ideal icosahedra in a bcc lattice, with different positions and occupancies than those proposed in previous work. Since neutrons and x rays have very different scattering amplitudes for Al, Li, and Cu, and since their respective diffraction profiles therefore consist of different peak intensities, the close agreement of the structural parameters from the two fits is a strong argument for the correctness of our results. These should be useful in packing-model descriptions of the related icosahedral phase.

27704 **Optical properties of submicrometer-size silver needles.** Bloemer, M.J.; Ferrell, T.L.; Buncick, M.C.; Warmack, R.J. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6123). *Physical Review [Section] B: Condensed Matter;* 37: No. 14, 8015-8021(15 May 1988). Contract AC05-84OR21400.

We present results of absorbance measurements in the range of 300—900 nm on submicrometer-size solid silver needles with

aspect ratios near 7:1. The needles have parallel major axes and are formed on a transparent substrate. The needles are modeled as prolate spheroids with shapes determined from electron micrographs. Absorbance spectra as a function of wavelength, polarization, and angle are compared to theoretical absorbance curves derived from electrodynamic theory.

27705 **Spin and orbital contributions to the dynamical structure factors of paramagnetic transition metals.** Trohidou, K.N.; Blackman, J.A.; Cooke, J.F. (National Research Center "Demokritos," Aghia Paraskevi Attikis, Greece). *Physical Review [Section] B: Condensed Matter;* **37**: No. 14, 8154-8166(15 May 1988).

Calculations have been made of the wave-vector-dependent dynamical structure factor for the itinerant transition metals V, Nb, Rh, and Pd. For inelastic neutron scattering there is a spin and an orbital contribution. The purpose of this work is a comparison of the relative magnitude of the two contributions. An important conclusion from the numerical work is the likely importance of the orbital part for a wide range of energy and momentum transfers.

27706 **X-ray photoemission study of δ-Pu stabilized by 1 wt. % Ga: Electronic structure and sputter-induced surface phase transformation.** Cox, L.E. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **37**: No. 14, 8480-8483(15 May 1988).

Photoemission spectra of the core (4f) and valence levels of Ar-ion-sputtered, Ga-stabilized δ-Pu are similar to those of α-Pu. This disordered α- or β-like surface layer is readily transformed by mild annealing (225 °C) to the δ allotrope as evidenced by profound changes in 4f spectrum. We attribute these changes to a transition from predominantly f-like final-state screening in the α-like phase to predominantly d-like screening in the fcc allotrope. The latter also shows a broadened valence band, presumably resulting from many-body effects associated with incipient localization of the 5f electrons.

27707 **Prediction of a large polar Kerr angle in NiUSn.** Daalderop, G.H.O.; Mueller, F.M.; Albers, R.C.; Boring, A.M. (Center for Materials Science and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **52**: No. 19, 1636-1638(9 May 1988).

An ab initio calculation of the magneto-optic Kerr effect is reported for ferromagnetic NiUSn. The double polar Kerr angle 2Phi is predicted to be about 10° in the infrared and about 4° in the visible spectrum. It is concluded that substitutional alloys involving C/sub l//sub >//sub b//sub =/ phase materials and uranium atoms are important candidates for device applications.

27708 **Scanning tunneling microscopy of the local atomic structure of two-dimensional gold and silver islands on graphite.** Ganz, E.; Sattler, K.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 18, 1856-1859(2 May 1988).

Small, two-dimensional islands of silver and gold formed in situ by evaporation onto graphite cleaved in ultrahigh vacuum are imaged atom by atom with a scanning tunneling microscope. These islands contain ordered regions of roughly 50 atoms in rectangular lattices, incommensurate with the substrate lattice, that are not close packed as in the bulk fcc structure. In one series of images, the shorter lattice spacing remained constant at 2.35 +- 0.15 A whereas the longer decreased from 4.05 +- 0.1 to 3.5 +- 0.1 A over a period of roughly 10 min.

27709 **Local premelting about impurities.** Stern, E.A.; Zhang, K. (Department of Physics, University of Washington, Seattle, Washington 98195). *Physical Review Letters;* **60**: No. 18, 1872-1875(2 May 1988).

X-ray-absorption fine-structure measurements were made on pure Pb and dilute solid solutions of Hg in Pb. These measurements are consistent with a model of local premelting of bonds around the Hg impurities beginning around 400 K, which is 180 °C below the bulk melting temperature of the alloy. The results imply that initiation of bulk three-dimensional melting may occur around point defects, even for pure materials.

27710 **Liquid potassium—antimony alloys: Investigation of some thermodynamic properties.** Saboungi, M.; Ellefson, J.; Johnson, G.K.; Freyland, W. (Argonne National Laboratory, Argonne, Illinois 60439-4837). *Journal of Chemical Physics;* **88**: No. 9, 5812-5817(1 May 1988). Contract W-31-109-ENG-38.

High-temperature emf measurements of the activity of potassium in liquid K—Sb alloys were carried out at T = 921 K for compositions covering the range X/sub K/ = 0 to 0.65. A solid electrolyte of potassium-substituted beta alumina was used in a coulometric titration technique to generate in situ potassium. The limiting slope of ln γ/sub K/ vs X/sub K/ (γ/sub K/ being the activity coefficient of K) was negative, which indicates that the alkali atoms tend to form clusters, such as dimers and higher order species. An inflection point in ln γ/sub K/ was found at the equiatomic composition, leading to a maximum in the Darken excess stability functions. This feature, which was recently observed in equiatomic alloys formed between Na or K and Bi, Pb, or Te, can be interpreted in terms of the formation of stable species. An investigation of the enthalpies of KSb as a function of temperature showed a relatively small excess heat capacity in the temperature range T = 878 to 1100 K.

27711 **Interlayer exchange in magnetic superlattices (invited).** Yafet, Y.; Kwo, J.; Hong, M.; Majkrzak, C.F.; O'Brien, T. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Journal of Applied Physics;* **63**: No. 8, 3453-3457(15 Apr 1988).

A simple model for calculating the Ruderman—Kittel—Kasuya—Yosida exchange interaction between layers of a magnetic rare-earth (RE) metal separated by yttrium is presented. The calculation is semiphenomenological and makes use only of previously measured or calculated quantities. It is valid when the thickness of the magnetic RE layers is much smaller than that of the Y layers. The coupling is found to be of fairly long range and to be consistent in sign with the ordering observed in Gd-Y superlattices. For the actual case of comparable layer thicknesses, a discussion of the superlattice wave functions is given. We show that our simple model is very plausible for constituent metals with simple band structures. For the actual band structure of Gd, eigenstates that are evanescent in the Gd region may provide a justification of our model and account for the agreement with experiment. Further theoretical and experimental work is necessary for understanding these systems.

27712 **X-ray scattering study of the magnetic phase transformation in GdB_6.** Galera, R.M.; Osterman, D.P.; Axe, J.D.; Kunii, S.; Kasuya, T. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* **63**: No. 8, 3580-3582(15 Apr 1988). Contract AC02-76CH00016.

Gadolinium hexaboride is thought to have at least two magnetic phases in zero magnetic field. The structure of these phases, however, is still unknown. Due to the high neutron absorption of both Gd and B, studies by neutron scattering are not easy to do. We therefore used the alternative technique of x-ray magnetic scattering. Experiments were performed with a rotating anode x-ray source and CuKα radiation at temperatures down to 6 K. At the lowest temperatures two sets of superlattice reflections of the form (h/2,k,l) and/or (h,k/2,l) and (h/2,k/2,l)= were observed. The intensity of both types of reflection remains roughly constant until 10 K. At this temperature the intensities of the (h/2,k,l) and (h,k/2,l) reflections increase sharply and reach a maximum around 11.5 K, while the (h/2,k/2,l) reflections rapidly disappear. At 12 K, only the former reflections are observed and they disappear discontinuously at T/sub N/ = 15.85 +- 0.5 K. The results confirm the existence of two magnetic phase transitions in GdB_6 and suggest a complex multi-q magnetic structure.

27713 **Photoemission study of 5f localization in UPd/sub 3-//sub x/(Pt,Rh)/sub x/.** Arko, A.J.; Koelling, D.D.; Dunlap, B.D.; Mitchell, A.W.; Capasso, C.; del Giudice, M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **63**: No. 8, 3680-3682(15 Apr 1988).

Photoemission measurements in the two systems UPd/sub 3-//sub x/(Pt,Rh)/sub x/ show that the 5f spectra are consistent with localized 5f electrons (peak in spectral weight is below E/sub F/ for all x within the double hexagonal DO_{24} phase) while at both phase transitions the 5f peaks lock in at E/sub F/ consistent with intinerancy. A satellite 5f peak which we attribute to d screening is observed in both localized and itinerant systems.

27714 **Epitaxial film growth and metastable phases of single crystal Dy by molecular beam epitaxy.** Yang, K.; Homma, H.; Schuller, I.K. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **63**: No. 8, 4066-4068(15 Apr 1988). Contract W-31-109-ENG-38;.

We have grown two novel epitaxial phases of dysprosium (Dy) on vanadium (V) by the molecular beam epitaxy technique. Surface structures are studied by in situ reflection high-energy electron diffraction, and bulk structures are studied by x-ray diffraction after removal from the growth chamber. The new hcp phases are ~4% expanded uniformly in the (0001) plane and ~9% and ~4% expanded out of plane, along the c axes, for noninterrupted and interrupted deposition cases, respectively. We also observed (2 x 2), (3 x 3), and (4 x 4) Dy surface reconstruction patterns and a series of structural changes as the Dy film thickness increases.

27715 **Extreme ultraviolet reflectance degradation of aluminum and silicon from surface oxidation.** Scott, M.L.; Arendt, P.N.; Cameron, B.J.; Saber, J.M.; Newnam, B.E. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Optics;* **27**: No. 8, 1503-1507(15 Apr 1988).

We have performed in situ oxide contamination and XUV reflectance vs angle of incidence studies on fresh aluminum and silicon films evaporated in an ultrahigh vacuum system (base pressure 2 x 10/sup -10/ Torr). Our ellipsometric measurements indicate that a surface monolayer of oxide forms on aluminum (1 h at 2 x 10/sup -8/-Torr oxygen) and silicon (1 h at 10/sup -7/-Torr oxygen). The monolayer formation time is inversely proportional to oxygen pressure. Our reflectance vs angle of incidence measurements at 58.4-nm wavelength indicate that unoxidized aluminum and silicon coatings can be used as multifacet retroreflectors with net retroreflectances in excess of 75% for aluminum and 50% for silicon.

27716 **Disclinations: The magnetism and the magnetic anisotropies of the rare-earth—3d transition-metal hard magnets (invited).** Watson, R.E.; Bennett, L.H.; Melamud, M. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* **63**: No. 8, 3136-3138(15 Apr 1988). Contract AC02-76CH00016.

An important class of hard magnets, involving rare earth and 3d transition metals and sometimes metalloids, includes $Nd_2Fe_{14}B$ and Nd_2Fe_{17}. We have noted a correlation between the local site magnetism in these two compounds and whether those sites lie on nets of so-called major ligand lines or disclinations, i.e., bond lines shared by six common nearest neighbors. We have proposed that a criterion for choosing candidate alloys with strong 3d moments is the occurrence of such disclination nets, and using this criterion, have listed several structures having 3d sites with this characteristic. We have also rationalized the crystal field anisotropies as relating to the orientation of the major ligand lines.

27717 **Field-dependent behavior of longitudinal ultrasonic attenuation in UPt_3.** Xu, M.; Schenstrom, A.; Baum, H.; Qian, Y.J.; Ketterson, J.B.; Hinks, D.; Levy, M.; Sarma, B.K. (Department of Physics, University of Wisconsin at Milwaukee, Milwaukee, Wisconsin 53201). *Journal of Applied Physics;* **63**: No. 8, 3420-3421(15 Apr 1988).

A possible phase transition is evident in the field dependent behavior of the ultrasonic attenuation in UPt_3. In the low field region the behavior is linear and in the high field region close in H/sub $c/_2$ the behavior is quadratic in $h' = (H/sub\ c/_2-H)/H/sub\ c/_2$. At the crossover there is a small peak in the ultrasonic attenuation. The temperature dependence of the coefficients a(T), for the linear behavior, and b(T), for the quadratic behavior are obtained.

27718 **Effects of chemical and magnetic disorder in Fe/sub 0.50/Mn/sub 0.50/.** Johnson, D.D.; Pinski, F.J.; Stocks, G.M. (Condensed Matter Physics Branch, Naval Research Laboratory, Washington, DC 20375-5000). *Journal of Applied Physics;* **63**: No. 8, 3490-3492(15 Apr 1988).

We present the results of first-principles calculations of the total energy and spin-polarized electronic structure of disordered fcc Fe/sub 0.50/Mn/sub 0.50/. These self-consistent calculations were performed using the Korringa—Kohn—Rostoker method and the coherent-potential approximation (KKR-CPA), using the local-spin-density approximation to treat exchange and correlation. We use a lattice constant of a = 6.80 a.u.; information about stability can be inferred from calculated pressure and energy. The moments on the Fe and Mn sites are large but antiparallel to each other, resulting in a small net magnetization. A comparison of the electronic structure is made for fcc Fe, Mn, and FeMn in both the ferromagnetic and disordered local moment states.

27719 **Structural and magnetic properties of Au/Pd/Au sandwiches: A total energy all-electron approach.** Hong, S.C.; Fu, C.L.; Freeman, A.J. (Physics Department, Northwestern University, Evanston, Illinois 60201). *Journal of Applied Physics;* **63**: No. 8, 3655-3656(15 Apr 1988).

The possibility of magnetism induced in Pd when sandwiched between Au layers, first proposed and studied experimentally by Brodsky and Freeman, is investigated by means of highly precise all-electron total energy local spin-density calculations employing the thin-film full-potential linearized augmented plane wave (FLAPW) method. Total energy local density calculations are employed on a Au/Pd/Au sandwich with three Pd layers to obtain the structural properties and five Pd layers to obtain the magnetic properties of an Au/Pd/Au sandwich. Detailed results are obtained with spin polarized calculations for the Pd lattice constant stretched taking into account (i) the misfit between the lattice constants of Au and Pd and (ii) proximity effects in a self-consistent way. The magnetic moment of the center Pd layer is found to be 0.02μ/sub B/ which is consistent with the experiment of Brodsky. A negligible magnetic moment for the interface Pd layers is obtained.

27720 **Shift in maximum of sound attenuation with magnetic field in UPt_3.** Baum, H.; Xu, M.; Qian, Y.J.; Schenstrom, A.; Ketterson, J.B.; Hinks, D.H.; Levy, M.; Sarma, B.K. (Physics Department, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201). *Journal of Applied Physics;* **63**: No. 8, 3686-3688(15 Apr 1988).

We have measured ultrasonic attenuation and ac susceptibility simultaneously on a UPt_3 single crystal, in various constant magnetic fields at 293 MHz, and in zero field at several frequencies. The temperature of the attenuation maximum T/sub m//sub α/ appears lower than (or very close to) the susceptibility transition temperature T/sub c//sub chi/. A breakpoint is defined, which occurs always at a lower temperature T/sub bp/ than T/sub m//sub α/. The shift of this breakpoint, T/sub c//sub chi/ -T/sub bp/, exhibits a small frequency dependence.

27721 **Unstable valence rare earths ion implanted into transition metals: Valence variation studies.** Lu, F.; Gunapala, S.; Croft, M.; Stoffel, N.G.; den Boer, M.L. (Rutgers University, Piscataway, New Jersey 08855-0849). *Journal of Applied Physics;* **63**: No. 8, 3692-3694(15 Apr 1988).

The technique of ion implantation is applied to study the problem of valence instabilities of Ce and Eu in transition-metal hosts. L_α x-ray absorption spectroscopy measurements are used to probe the rare-earth valence state in these materials. Typical extreme valence variations are illustrated with Y, Ti, and Pd hosts. The important question of identifying extrinsic oxidation of the rare-earth implant is addressed in detail. The signatures of rare earth oxidation in the x-ray spectra of both bulk compound and implanted materials are discussed using specific examples.

27722 Magnetic properties of Sm-Ti-Fe and Nd-Ti-Fe hard and soft sputtered phases. Kamprath, N.; Wickramasekara, L.; Hegde, H.; Liu, N.C.; Jayanetti, J.K.D.; Cadieu, F.J. (Physics Department, Queens College of CUNY, Flushing, New York 11367). *Journal of Applied Physics;* **63**: No. 8, 3696-3698(15 Apr 1988).

A series of Sm-Ti-Fe and Nd-Ti-Fe film samples have been synthesized by rf diode sputtering for Fe-rich compositions. Samples have been directly crystallized onto heated substrates as well as first deposited amorphous and then subsequently crystallized. In the film plane magnetic fields have been applied during the deposition and during the crystallization to induce in-the-film-plane anisotropies into the films. A phase that contained only Sm, Ti, and Fe has been synthesized in film form that exhibited an in-plane intrinsic coercive force, /sub i/H/sub c/, of 31 kOe at room temperature and 58 kOe at 5 K. Tetragonal lattice parameters with a = 8.391 A and c = 12.297 A have been assigned to the high /sub i/H/sub c/ phase by a fitting to 12 diffraction lines. The Nd-Ti-Fe and the Sm-Ti-Fe systems also exhibited a soft magnetic phase of the $ThMn_{12}$-type at a nominal composition of $Nd(TiFe_{11})$.

27723 Magnetic properties of rapidly quenched and annealed $Fe_{10}RTi$ and related alloys. Zhao, Z.R.; Ren, Y.G.; Aylesworth, K.D.; Sellmyer, D.J.; Singleton, E.; Strzeszewski, J.; Hadjipanayis, G.C. (Behlen Laboratory of Physics, University of Nebraska, Lincoln, Nebraska, 68588-0111). *Journal of Applied Physics;* **63**: No. 8, 3699-3701(15 Apr 1988).

Magnetic measurements are reported for iron-rich ternary alloys with the following compositions: $Fe_{10}Nd$/sub x/Dy_1/sub -// sub x/Ti ($0 \leqq x \leqq 1$), $Fe_{10}SmM$ (M = Ti, V, and Mo), and $Fe_{10}RV$ (R = Y, Gd, and Dy). The samples were prepared by splat cooling or melt spinning and selected samples were heat treated. The results of x-ray diffraction, electron microscopy, and thermomagnetic measurements on the $Fe_{10}Nd$/sub x/Dy_1/sub -//sub x/Ti series are presented and indicate that the rapidly quenched alloys are nearly single phase and become multiphase upon heating. Magnetic measurements on the other two series show that the substitution of V for Ti increases the saturation magnetization.

27724 Effect of Ga substitution on the magnetic properties of $Nd_2Fe_{14}B$, $Pr_2Fe_{14}B$, and $PrCo_5$. Pedziwiatr, A.T.; Sankar, S.G.; Wallace, W.E. (Mellon Institute and Metallurgical Engineering and Materials Science Department, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213). *Journal of Applied Physics;* **63**: No. 8, 3710-3712(15 Apr 1988).

R_2Fe/sub 14-//sub x/Ga/sub x/B (R = Pr and Nd) and PrCo/sub 5-//sub x/Ga/sub x/ alloys were synthesized and examined by powder x-ray diffraction at room temperature and by magnetometry in the temperature range 4.2—1100 K. Lattice parameters, Curie temperature, spin-reorientation temperatures, anisotropy fields, and saturation magnetizations were determined. Phase analysis revealed that single-phase materials exist only for $x \leqq 1$ in the case of 2:14:1 alloys and for $x \leqq 2$ for 1:5 alloys. An increase in lattice parameters is observed upon Ga substitution in all cases. About 20 K increase in the Curie temperature is observed for 2:14:1 alloys, whereas there is a dramatic decrease in 1:5 alloys. Saturation magnetization values decrease upon Ga substitution. The anisotropy field is slightly enhanced by Ga addition in the Nd_2Fe/sub 14-//sub x/Ga/sub x/B system. Spin-reorientation phenomena in Nd_2Fe/sub 14-//sub x/Ga/sub x/B and PrCo/sub 5-//sub x/Ga/sub x/ are strongly affected by Ga addition. The observed behavior is discussed in terms of preferential substitution of Ga atoms into the $Nd_2Fe_{14}B$-type crystal structure and random substitution into the $CaCu_5$-type crystal structure.

27725 Electronic structure and spin density of $Gd_2Fe_{14}B$. Ching, W.Y.; Gu, Z. (Department of Physics, University of Missouri-Kansas City, Kansas City, Missouri 64110). *Journal of Applied Physics;* **63**: No. 8, 3716-3718(15 Apr 1988).

The electronic structure of $Gd_2Fe_{14}B$ has been calculated using the spin-polarized orthogonalized linear combination of atomic orbitals method. The use of the band approach to study the magnetic properties of the rare-earth iron-boron compounds should be more valid in the case of $Gd_2Fe_{14}B$ because of the exactly half-filled f shell of the Gd atom, which has a zero orbital angular momentum. The calculated total spin magnetic moment of 18.41 μ/sub B/ per formula unit is in good agreement with experiment, and the site-decomposed Fe moments show that the j_2 site has the highest and the e site has the smallest moment. Other results presented include total and partial density of states and the spin density distributions on the basal and [110] plane. The positive spin density from the Fe sites shows a network type of structure parallel to the c axis. These and other results are compared with those calculated for $Nd_2Fe_{14}B$.

27726 Brillouin scattering from collective spin waves in magnetic superlattices (invited). Hillebrands, B.; Boufelfel, A.; Falco, C.M.; Baumgart, P.; Guentherodt, G.; Zirngiebl, E.; Thompson, J.D. (Optical Sciences Center, University of Arizona, Tucson, Arizona 85721). *Journal of Applied Physics;* **63**: No. 8, 3880-3884(15 Apr 1988).

We report on the observation and the analysis of collective magnetostatic spin-wave excitations in magnetic superlattices. The influence of interface anisotropies, which can become dominant for small modulation wavelengths, is discussed. For the system Fe/Pd we show that Brillouin spectroscopy experiments in combination with the measurement of the saturation magnetization by a SQUID magnetometer give evidence for a magnetic polarization of the Pd spacer layers, as well as for a small negative out-of-plane interface anisotropy constant of K/sub s/ = -0.15 erg/cm^2.

27727 Observation of high-temperature spin fluctuations in UBe_{13} by nuclear-spin relaxation. Clark, W.G.; Wong, W.H.; Hines, W.A.; Lan, M.D.; MacLaughlin, D.E.; Fisk, Z.; Smith, J.L.; Ott, H.R. (Department of Physics and Solid State Science Center, University of California, Los Angeles, California 90024). *Journal of Applied Physics;* **63**: No. 8, 3890-3892(15 Apr 1988).

We report the extension of measurements of the ^{9}Be spin-lattice relaxation rate in UBe_{13} from 300 up to 1000 K. They reflect the fluctuating local magnetic field at the site of the ^{9}Be nuclei. Above about 100 K, there appears a new contribution in addition to the rate observed at lower temperatures. The high temperature contribution is modeled in terms of the thermal excitation of low-lying states of the U^{3+} ion along lines used by Felton et al. to explain their measurements of the specific heat. Our results indicate a splitting of 200 +- 20 K between the ground and excited states of the system, and a lifetime of 8×10^{-14} s for the excited states (width = 95 K).

27728 Magnetic correlations in amorphous Fe-Zr alloys. Rhyne, J.J.; Erwin, R.W.; Fernandez-Baca, J.A.; Fish, G.E. (Institute for Materials Science and Engineering, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Applied Physics;* **63**: No. 8, 4080-4082(15 Apr 1988).

Results of high-resolution small-angle neutron scattering (SANS) studies on amorphous alloys of composition Fe/sub x/Zr/ sub 100-//sub x/, x = 90, 91, 92, show that ferromagnetic correlations exist below T/sub c/, but that conventional long-range order is destroyed by competing exchange interactions. The transition temperatures drop with increasing iron concentration (T/sub c/ $\simeq$226 K for $Fe_{90}Zr_{10}$ down to T/sub c/ $\simeq$175 K for $Fe_{92}Zr_8$). Data taken at very low Q ($0.008\ A^{-1} < Q < 0.02\ A^{-1}$) provide evidence of relatively large ($\simeq$200—$\simeq$400 A) static spin clusters which do not disorder at T/sub c/. Superposed on this is an ordering with a second shorter length scale which shows a cusp (not divergent) at the bulk T/sub c/. The data were fitted to a combination of a Lorentzian and a power of a Lorentzian, the latter of which represents scattering from clusters with a Maxwellian distribution of sizes.

27729 Isomer shift and magnetic properties of EuO under pressure. Taylor, R.D.; Farrell, J.N. (Physics Division, MS K764, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **63**: No. 8, 4108-4109(15 Apr 1988).

We have measured the Moessbauer effect of ^{151}Eu in EuO at temperatures down to 4 K and pressures to 31 GPa. At ambient pressure EuO becomes ferromagnetic at T/sub C/ = 69 K; at 31 GPa, T/sub C/ = 105(2) K; and a maximum value of T/sub C/ in

the region 15—25 GPa is inferred. A Brillouin fit of the hyperfine-field-temperature data at 31 GPa gives a reduced magnetic moment compared to ambient although the magnitude of the saturation hyperfine field is not reduced. The isomer shift with pressure weakly supports the expectation of an intermediate-valence change with pressure above 14 GPa.

27730 **Large single crystal quaternary alloys of IB-IIIA-SE/sub 2/ and methods of synthesizing the same.** Ciszek, T.F. (to Dept. of Energy, Washington, DC). US Patent 4,721,539. 26 Jan 1988. Filed date 15 Jul 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes Quaternary IB-IIIA-Se/sub 2/ alloys of high-quality, single crystal chalcopyrite structure having large single crystal grains greater than about 5mm and free of cracks and voids of the size which interfere with good optical absorption coefficients and high band-gap energies. The alloy structure are selected from the group consisting of Cu/sub chi/Ag/sub (l-chi)/InSe/sub 2/ and CuIn/sub y/Ga/sub (l-y)/Se/sub 2/, where chi is in the range of about 0.65 to 0.8, and where y is in the range of about 0.85 to .095, produced by the process comprising the steps of: placing in a refractory container a reaction mixture of Cu, Ag, In, and Se, or a reaction mixture of Cu, In, Ga, and Se, where such reaction mixture is calculated by atomic percent to produce and desired alloy; placing B/sub 2/O/sub 3/ in the container in a quantity sufficient for the B/sub 2/O/sub 3/ to completely cover and encapsulate the reaction mixture when the B/sub 2/O/sub 3/ is melted; placing the container and its the reaction mixture and B/sub 2/O/sub 3/ contents in an enclosed chamber; creating an environment of pressurized inert or nonreactive gas in the enclosed chamber and over the container and its contents; while containing the environment of pressurized gas, heating the container and its the contents to a temperature to at least completely melt the contents of the container, and holding such temperature for a sufficient period of time to equilibrate the melt and synthesize and alloy; and then lowering the temperature of the melt in a controlled manner to solidify it as a quaternary IB-IIIA-Se/sub 2/ alloy of high-quality, single-crystal chalcopyrite structure.

27731 (SAND—87-1343-Vol.11-No.2, pp 10-15) **Feedback control of gas tungsten-arc welding.** Dec 1987. NTIS, PC A03/MF A01. Order Number DE88005955/JAW.

In Sandia technology: Volume 11, No. 2.

The problem of ensuring the integrity of small-pressure-vessel welds recurs at Sandia and elsewhere. This article describes a feedback-control system for gas tungsten-arc welds, based on direct, noninterfering observation of light given off from the back side of the weld being produced; it was made possible by developments in light imaging and sensing techniques. In this system, information about the intensity of the light is fed back through a computer to control the arc current. This automatic control system, in proof tests, has proved effective in maintaining quality under changing circumstances. 7 figures.

27732 (SAND—87-1343-Vol.11-No.2, pp 16-21) **Electroforming: art in science.** Dec 1987. NTIS, PC A03/MF A01. Order Number DE88005955/JAW.

In Sandia technology: Volume 11, No. 2.

Electroforming is valuable for special applications in nuclear weapon R and D, the best method to use when there is need to fabricate only a few parts that have complex shapes or thin cross sections; sometimes, it is the only method for providing a part. Three examples of special-purpose parts, made by use of electroforming, are presented here: (1) a cable shield for and underground nuclear test; (2) a complex-shaped part consisting of a capped, hollow cylinder with grooves every 20° around its circumference; and (3) a nickel particle collector a real-time mass detector for particulate material. Thus electroforming, born of art 150 years ago, continues to make significant contributions to science and high technology. 8 figures.

27733 (SAND—87-1343-Vol.11-No.2, pp 22-27) **Scientific aspects of welding.** Dec 1987. NTIS, PC A03/MF A01. Order Number DE88005955/JAW.

In Sandia technology: Volume 11, No. 2.

Complete 3-dimensional calculations of fluid convection within the weld pool are not possible even with today's advanced computers. Therefore, an axisymmetric non-travelling weld, such as a spot weld, was calculated, exploring surface tension which is the primary driving force for convection. The calculational methods developed can help in all stages of weld process development - in weld sample design, in field studies, and in understanding effects of material, properties such as surface tension. 7 figures.

27734 **Thermodynamic and transport properties of $CeCu_6$.** Amato, A.; Jaccard, D.; Flouquet, J.; Lapierre, F.; Tholence, J.L.; Fisher, R.A.; Lacy, S.E.; Olsen, J.A.; Phillips, N.E. (Universite de Geneve (Switzerland)). *Journal of Low Temperature Physics;* **68**: No. 5/6, 371-397(Sep 1987). Contract AC03-76SF00098.

Measurements of the specific heat, magnetization, and transport properties (resistivity, thermoelectric power, and thermal conductivity) of single-crystal $CeCu_6$ are reported with special emphasis on the effect of magnetic field. The relative field variations of the differential susceptibility, the coefficients of the linear temperature term of the specific heat, and the T^2 resistivity term are presented. They are directly related to the field curvature of the magnetization, indicating the itinerant nature of the f electrons. The Wilson ratio reaches a maximum at $H = H^*$, which may correspond to a crossover from a low-field phase in which antiferromagnetic correlations dominate, to a highly polarized phase. Intersite coupling seems to play an important role in heavy-fermion compounds. Another interesting result is the occurrence of residual positive magnetoresistivity, which also appears to be a general feature of heavy-fermion compounds. The properties of $CeCu_6$ are compared to those of other f instability compounds and to present theories.

27735 **Irradiation effects in metals.** Caskey, G.R. Jr. (Savannah River Lab. (USA)). pp 627-630 of Environmental degradation of engineering materials. Louthan, M.R.; McNitt, R.P. University Park, PA; Pennsylvania State University (1987). (CONF-870466—).

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

Irradiation damage studies have been reviewed to highlight research of current interest. Emphasis is on swelling, creep, fracture, and helium embrittlement.

27736 **Tritium imaging and its potential for detecting tritium segregation to grain boundaries.** Malinowski, M.E. (Sandia National Labs., Livermore (USA)). pp 609-618 of Environmental degradation of engineering materials. Louthan, M.R.; McNitt, R.P. University Park, PA; Pennsylvania State University (1987). (CONF-870466—). Contract AC04-76DP00789.

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

Tritium imaging is a real-time, non-contact tritium detection technique which has potential applications in metallurgical studies of hydrogen embrittlement. The physical basis of imaging, its possible uses in measuring tritium distributions in materials, and the system currently used to perform measurements are described. The technique's advantages and disadvantages are discussed using images of metal tritides and implanted graphite to illustrate the resolution and quality of images currently obtained. The application of imaging to study grain boundary segregation in metals is addressed, and the minimum segregation which should be detectable with the present apparatus corresponds to a segregation coefficient of about 200.

27737 **Degradation of mechanical properties of stainless steels containing high and low helium concentrations.** Bajaj, R.; Bagnall, C.; Caskey, G.R. Jr.; Birchenall, A.K. (Westinghouse Electric Corp. (USA)). pp 605-608 of Environmental degradation of engineering materials. Louthan, M.R.; McNitt, R.P.; Sisson, R.D. University Park, PA; Pennsylvania State University (1987). (CONF-870466—).

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

Austenitic stainless steels have been selected as structural materials in both fission and fusion reactors. In these applications, the mechanical properties of the materials may be degraded because

of accumulations of helium. Generation of helium may limit the useful lifetime of reactor components. In the reactor environment, helium is produced by transmutation of boron, present as an impurity or as an additive, and the alloy element nickel, through B/sup 10/(n,α)Li/sup 7/ and Ni/sup 58/(n,γ) → Ni/sup 59/(n,α)Fe/sup 56/ reactions, respectively. Simulation techniques have been employed to study the helium effects in which helium is introduced into the microstructure by ion implementation, or through tritium decay following a tritium diffusion treatment. This paper attempts to combine the mechanical property data on materials containing a broad range of helium concentration: from 0.1 appm (atomic parts per million) to several hundred appm. Fundamental trends over a wide range of temperatures, from ambient to —1,300 K, are established. Considerations are limited to stainless steels in a solution annealed condition, and data are given for materials containing helium that originated from the three sources mentioned above. Extensive literature, dealing with the effects of helium on cold-worked type 316 stainless steel, is reviewed elsewhere. The effects of helium on the room temperature mechanical properties of austenitic stainless steel become apparent at about 30 appm helium. Yield strength increases, while ductility and fracture toughness are reduced.

27738 **Tensile properties of welded helium-charged 304L stainless steel.** Robinson, S.L. (Sandia National Labs., Livermore (USA)). pp 591-592 of Environmental degradation of engineering materials. Louthan, M.R.; McNitt, R.P.; Sisson, R.D. University Park, PA; Pennsylvania State University (1987). (CONF-870466—). Contract AC04-76DP00789.

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

The formation of helium in structural materials is a byproduct of both fission and fusion energy technologies. Helium may be produced by the transmutation of /sup 10/B, from the two step decomposition of /sup 59/Ni, by the implantation of energetic /sup 4/He particles or by tritium decay. Although it is chemically inert and essentially insoluble in the metal lattice, helium levels as low as 0.1 atomic ppm produced by irradiation have been shown to produce significant embrittlement at high temperatures. However, ambient temperature tensile data on heat-affected zone (HAZ) properties of helium containing stainless steels are scarce. Because welding of helium-containing stainless steels may be required in these structures, this study was performed to determine the effect of helium on the HAZ tensile properties of a Gas-Tungsten Arc (GTA) plate-on-plate weld in annealed 304L stainless steel. Helium-containing tensile specimens were prepared by thermally charging these samples with high pressure tritium, aging in a freezer to produce 526 atomic ppm of /sup 3/He, and thermally degassing the tritium at a low temperature. The samples were then exposed in a Gleeble /sup R/ machine to simulate HAZ thermal cycles which were based upon experimental measurements. Peak temperatures of 1073K, 1273K and 1473K were obtained by closed-loop temperature control, followed by ambient temperature tensile tests.

27739 **The uses of tritium in hydrogen transport and embrittlement studies.** Robinson, S.L. (Sandia National Labs., Livermore (USA)). pp 565-578 of Environmental degradation of engineering materials. Louthan, M.R.; McNitt, R.P.; Sisson, R.D. University Park, PA; Pennsylvania State University (1987). (CONF-870466—). Contract AC04-76DP00789.

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

Tritium has found a number of uses in experimental studies of hydrogen transport and embrittlement in metals, both in tracer quantities and at high concentrations. The majority of experimental techniques involving tritium use its radioactive decay which yields both β radiation and the daughter product /sup 3/He, to determine the parent tritium (hydrogen) concentration, distribution and flux. The current experimental techniques using tritium are described, with attention to the advantages and limitations of the methods. Some important experiments and their interpretation are discussed, and, where appropriate, potential applications are explored.

27740 **Nuclear-reaction analysis of helium-3 and tritium in tritium-exposed austenitic steels.** Myers, S.M. (Sandia National Labs., Albuquerque (USA)). pp 579-590 of Environmental degradation of engineering materials. Louthan, M.R.; McNitt, R.P.; Sisson, R.D. University Park, PA; Pennsylvania State University (1987). (CONF-870466—). Contract AC04-76DP00789.

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

Nuclear-reaction analysis can be used to profile /sup 3/He and tritium with high sensitivity and depth resolution in tritium-exposed alloys. Helium-3 is detected via the deuteron-induced reaction /sup 3/He(d,p)/sup 4/He with a sensitivity better than 0.1 appm and a depth resolution of tenths of a micrometer. The /sup 3/He decay product provides an essentially immobile trace of the diffusing tritium as a result of strong trapping at defects. The tritium itself can be profiled using the deuteron-induced reaction T(d,n)/sup 4/He; here the sensitivity is believed better than 10 appm, and the depth resolution is comparable to that for the /sup 3/He. Embrittlement-related applications of these analyses have included the determination of tritium diffusivities, solubilities and surface permeabilities and the measurement of composition in tensile specimens.

27741 **Rheological and aging characterization of elastomers.** Feng, W.W. (Univ. of California, Lawrence Livermore National Lab. (USA)). pp 445-452 of Environmental degradation of engineering materials. Louthan, M.R.; McNitt, R.P.; Sisson, R.D. University Park, PA; Pennsylvania State University (1987). (CONF-870466—).

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

The authors developed a constitutive equation for the viscoelastic and aging characteristics of elastomers subjected to large deformations. An experiment is designed for determining these mechanical properties quantitatively.

27742 **Microdiffraction with synchrotron radiation.** Ice, G.E. (Oak Ridge National Lab., TN (USA)). pp 397-399 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Storage ring sources are orders of magnitude brighter than the characteristic line of a rotating anode X-ray tube. This improved brightness alloys X-ray diffraction with micron spatial resolution. The authors report on preliminary microdiffraction experiments using synchrotron radiation. In these experiments, synchrotron radiation beams were passed through specially prepared heavy metal pinholes to achieve probes as small as 10 μm. Both white beam and monochromatic beam techniques are discussed and the relative merits are compared.

27743 **Small crack-environment interactions: The hydrogen embrittlement perspective.** Gangloff, R.P.; Wei, R.P. (Corporate Research Science Lab., Exxon Research and Engineering Co., Annandale, NJ 08801 (USA)). pp 239-264 of Small fatigue cracks. Ritchie, R.O.; Lankford, J. Warrendale, PA; The Metallurgical Society Inc. (1986). (CONF-860185—).

From 2. Engineering Foundation international conference on small fatigue cracks; Santa Barbara, CA, USA (5 Jan 1986).

The growth rates of small fatigue cracks (< 5 mm) may be significantly faster than expected, based on longer crack data at constant stress intensity, for hydrogenous gases and liquids, but predictable for inert environments. Experimental and modeling results are reviewed, predominantly for steels in aqueous electrolytes. The ratio of small to long crack growth rates is as high as 500 for high strength steels in 3% NaCl, and decreases with decreasing yield strength to between 6 and 1.2 for HY130 and low strength carbon steels, respectively. Limiting crack lengths for size independent growth are undefined, but can exceed 2 mm. Small crack-environment interactions are caused by differences in crack tip solutions and resulting hydrogen production rates. Environment enhanced

crack closure and localized crack tip plasticity are potential mechanisms, however, systematic studies are limited. Modeling predicts that hydrogen production increases within small, occluded cracks due to enhanced hydrolytic acidification and reduced oxygen reduction. Predictions demonstrate that the crack surface area to crack solution volume ratio affects the local environment and decreases significantly with increasing small crack size. The interplay between convection and diffusion modes of mass transport leads to a range of crack sizes where unique environmental conditions develop. At very long crack lengths, the local environment is unchanging with crack growth and the mechanical driving force describes corrosion fatigue. Future modeling must include clean surface electrochemical reaction kinetics for realistically shaped cracks, and must couple crack chemistry with brittle crack propagation.

27744 **Crack initiation and growth under far-field cyclic compression: Theory, experiments and applications.** Suresh, S.; Christman, T.; Bull, C. (Div. of Engineering, Brown Univ., Providence, RI 02912 (USA)). pp 513-540 of Small fatigue cracks. Ritchie, R.O.; Lankford, J. Warrendale, PA; The Metallurgical Society Inc. (1986). (CONF-860185—).

From 2. Engineering Foundation international conference on small fatigue cracks; Santa Barbara, CA, USA (5 Jan 1986).

The application of cyclic compressive loads can result in the propagation of fatigue cracks from stress concentrations (i.e., notch, void, etc.). Such cracks, initiated under the influence of residual tensile stresses in the vicinity of the stress concentration, generally grow at a progressively decreasing rate before arresting completely. Although the occurrence of this phenomenon has long been recognized, very little is known about the mechanics and mechanisms of crack advance under imposed cyclic compressive loads. In this paper, the authors examine the influence of stress state, crack-tip plasticity, load range and microstructure on the characteristics of crack initiation and (short crack) growth under fully compressive far-field cyclic loads. Some important applications of the phenomenon of crack initiation under far-field cyclic compression to the study of "long" and "short" (tensile) fatigue cracks are discussed. It is demonstrated that this phenomenon offers a useful tool for quickly obtaining estimates of fatigue crack growth thresholds while minimizing some of the uncertainties inherent in the conventional (load-shedding) procedures. Furthermore, the initiation of cracks from notches subject to remote compression is shown to offer some valuable insights into the growth and closure behavior of physically-small (tensile) cracks. The significance and limitations of the compression method are described.

27745 **Importance of undercooling in the formation of non-equilibrium structures in the Al-Ge alloy system.** Kaufman, M.J.; Fraser, H.L. (Univ. of Illinois, Urbana). *International Journal of Rapid Solidification;* 1: 27-50(1985). Contract AC02-76ER01198.

The importance of both undercooling and cooling rate in the microstructural development of Al-Ge alloys during rapid solidification has been determined. A new technique has been developed which permits such determinations to be performed directly in a transmission electron microscopy. This technique involves the in-situ melting and solidification of submicron powders for which it is possible to vary the cooling rate from the liquid of semi-solid state over a fairly large range while observing directly the various solidification microstructures. Further, a heating stage may be used either to measure the liquid undercoolings achieved upon slowly cooling or to select substrate temperatures (and so affect the nucleation temperatures) during rapid quenching experiments. In addition, splat quenched foils and amorphous films, heated with the electron beam to cause crystallization, have been analyzed. From these observations, it appears that rather specific temperature ranges exist, whether approached by down-quenching from the liquid state of up-quenching from the amorphous state, where the formation of certain combinations of phases becomes favorable and that the primary function of the cooling rate during rapid solidification is to inhibit nucleation processes so that substantial undercooling may be achieved. 49 references, 16 figures, 7 tables.

27746 **Molecular dynamic simulation of crack growth.** Dienes, G.J.; Sieradzki, K.; Paskin, A.; Massoumzadeh, B. (Brookhaven National Lab., Upton, NY 11973 (USA)). pp 85-98 of Modeling environmental effects on crack growth processes. Jones, R.H.; Gerberich, W.W. Warrendale, PA; The Metallurgical Society Inc. (1985). (CONF-8510160—). Contract AC02-76CH00016.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

Recent molecular dynamic simulations have shown that a 2D triangular Johnson (empirical iron potential) solid is brittle, compared with the behavior of a Lennard-Jones (L-J) solid. The crack velocity reaches a limiting velocity when the crack has grown by about 50 percent. The normalized (with respect to the longitudinal sound velocity) crack velocity vs the normalized (with respect to the initial length) crack length was found to be independent of the original crack length and the method of loading, indicating the absence of size effects. At high constant applied load, and hence high deformation, dislocation generation is observed with the crack completely stopped for a significant period of time.

27747 **A crack-tip chemistry and fracture mechanics-based model of the crack growth rate/stress intensity relationship for Ni+P.** Jones, R.H.; Danielson, M.J.; Oster, C.A. (Pacific Northwest Lab., Richland, WA 99352 (USA)). pp 41-54 of Modeling environmental effects on crack growth processes. Jones, R.H.; Gerberich, W.W. Warrendale, PA; The Metallurgical Society Inc. (1985). (CONF-8510160—). Contract AC06-76RL01830.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

A crack-tip chemistry model capable of describing the K/sub ISCC/ and stages I and II crack growth rate kinetics of Ni+P has been developed. This model incorporates the electrochemistry in the crack, IR drop effects, corrosion rate effects along the crack wall, material yield strength adn plastic flow properties, and crack geometry parameters. The model predicts that cracking proceeds with a well defined threshold followed by a stage I with a rapid increase in crack growth rate and a stage II in which the crack growth rate in independent of the stress intensity; however, the threshold is underpredicted. A discussion of crack-tip shielding and critical strain effects on these calculations is presented. A critical fracture strain concept can account for the difference in the calculated and measured K/sub ISCC/. Crack growth rates in the stage II regime are underpredicted by a factor of 5. Mechanical fracture occurring simultaneously with anodic dissolution could account for this difference, but direct evidence for such a process is not available.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 27676, 27742, 27769, 27874, 27875, 27875, 27908, 27908, 27953, 27976, 28363

27748 **(AD-A—188154/9/XAB) High-yield synthesis of B_4C/BN ceramic materials by pyrolysis of polymeric Lewis base adducts of decaborane(14). Technical report.** Rees, W.S.; Seyferth, D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 4 Nov 1987. 20p. (TR—24). NTIS, PC A03/MF A01.

In previous work, the authors developed useful polymeric precursors whose pyrolysis provides high yields of silicon nitride or silicon nitride/silicon carbide blends. The main applications of such preceramic polymers (preparation of ceramic fibers and coatings and their use as binders for ceramic powders) require that the polymeric precursor be processable, i.e., soluble in organic solvents and or fusible. Although the major efforts of workers in the preceramic polymer area have, to date, been directed toward the development of useful precursors for silicon carbide, silicon nitride, silicon carbonitride and silicon oxynitride, boron containing ceramics (the carbide, nitride, phosphides, silicides and others) are class of ceramic materials whose properties are very attractive in terms of high-technology applications. Thus, boron carbide has exceptional thermal stability (mp 2450 C), a microhardness of 4.05 GPa (vs 2.53 GPa for SiC), high compressive strength, and radiation stability.

Various routes exist for the preparation of boron carbide and boron nitride. For boron carbide, however, none of these proceed by way of a processable intermediate. For boron nitride, preparative routes based on the pyrolysis of silicon substituted, oligomeric borazines and of a boric acid/1,2,3-propanetriol condensation product have been reported. We report the results of our initial efforts to develop processible polymeric precursors whose pyrolysis gives boron-containing ceramic materials in high yield. The initial objective of our research was the preparation and evaluation of polymers which would serve as precursors for boron carbide or blends of boron carbide and boron nitride.

27749 **(AD-A—188202/6/XAB) Preparation and characterization of Co(II)/ZrO_2 solid solution. Technical report.** Wu, P.; Kershaw, R.; Dwight, K.; Wold, A. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). 27 Oct 1987. 10p. (TR—9). NTIS, PC A02/MF A01.

Samples of cubic zirconium oxide containing up to almost 10 at% cobalt were prepared by codecomposition of the nitrate. Magnetic susceptibility measurements confirmed the limit of solubility and the presence of the cobalt as Co(II). The reduction of the cobalt inserted in cubic zirconia took place at a considerably higher temperature than bulk cobalt oxide. Cubic ZrO_2 samples containing some transition metal oxides including rhodium oxide (1), iron oxide (2), chromium oxide (3) and nickel oxide (4) were studied previously in this laboratory. Their structures, magnetic properties and the stabilities towards reduction have been studied. ZrO_2 is characteristic of an absence of reaction between the ZrO_2 support and the catalyst. It is the purpose of this work to investigate the formation of solid solution between ZrO_2 and cobalt oxide and to study the magnetic properties of such a system. In addition, the stability towards reduction of cubic ZrO_2 samples containing various concentrations of reacted cobalt oxide will be determined.

27750 **(AD-A—188249/7/XAB) Preparation and characterization of $Ba_2YCu_3O_{7-}.01(2)$. Technical report.** Davison, S.; Smith, K.; Kershaw, R.; Dwight, K.; Wold, A. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). 27 Oct 1987. 10p. (TR—12). NTIS, PC A02/MF A01.

Sample of $Ba_2YCu_3O_7$ were prepared both by ceramic techniques using $BaCO_3$, Y_2O_3, and CuO as well as by the decomposition of the corresponding nitrates. The preparations by each method are discussed and compared. In addition, the chemical instability of the pure phase $Ba_2YCu_3O_7$ in moist air is discussed.

27751 **(AD-A—188448/5/XAB) Chemical problems associated with the preparation and characterization of superconducting oxides containing copper. Technical report.** Davison, S.; Smith, K.; Wold, A.; Zhang, Y.; Liu, J. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). 1987. 11p. (TR—11). NTIS, PC A03/MF A01.

Pub. in ACS (American Chemical Society) Symposium Series 351, 67-78(1987).

The superconducting oxides $La(1.8)Sr(0.2)CuO_4$ and $Ba_2YCu_3O_7$ were prepared by decomposition of mixed metal nitrates. Thermogravimetric analysis and electron-spin-resonance measurements indicated the presence of Cu(I) and Cu(III) in the $La(1.8)Sr(0.2)CuO_4$ phase. The compound $Ba_2YCu_3O_7$ prepared from the nitrates and subjected to an oxygen anneal at 425 C gave a sharp superconducting transition at 92 K. The phase was stoichiometric but readily decomposed when kept in contact with moist air.

27752 **(AD-A—188604/3/XAB) Reaction of thin metal films with crystalline and amorphous Al_2O_3.** Zhao, X.; Kolawa, E.; Nicolet, M. (California Inst. of Tech., Pasadena (USA)). Dec 1986. 4p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science and Technology A, Vol. 4, No. 6, 3139-3141(Nov-Dec 86).

The authors investigated the thermal reaction between thin transition-metal films and sapphire, alumina or amorphous Al_2O_3 using backscattering spectrometry and x-ray diffraction. Thin films of Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, and Pt were deposited on the substrates by rf sputtering in an Ar gas ambient. The samples were subsequently annealed in vacuum at 800-900 C for 20 min to 4 h duration. It was found that only films of Y, Ti, and Hf react, regardless of the type of substrate, by forming aluminides near the substrate and oxides on the surface. The other metal films do not react with the Al_2O_3 substrates. Results agree with thermodynamic consideration based on the heats of reactions between metals and Al_2O_3.

27753 **(AD-A—188711/6/XAB) Properties of reactively sputtered WNX films.** Kolawa, E.; So, F.C.; Zhao, X.; Nicolet, M.A. (California Inst. of Tech., Pasadena (USA)). 1987. 8p. NTIS, PC A02/MF A01.

Tungsten nitride (WNX) films were prepared by reactive rf sputtering of a tungsten target in N_2/Ar plasma. The resistivity, intrinsic stress, and atomic composition of the films were studied as functions of various sputtering parameters: sputtering power, gas pressure, gas composition, and substrate bias. The atomic percentage of nitrogen (x) of the WNX films was found to decrease with sputtering power and to increase with the partial pressure of nitrogen. The intrinsic stress if WNX is compressive. The dependence of film properties upon sputtering parameters for WNX differs significantly from that of reactively sputtered TiN films, and may be attributed to the difference in the formation mechanisms of TiN and WNX.

27754 **(Juel—2158) Statistical and systematic errors in the strength determination of brittle materials.** Bongartz, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Sep 1987. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753270/JAW.

A computer simulation method was set up to determine the scatter in the strength measurement on structural components (tubes) of ceramic materials caused by their Weibull strength distribution. The aim was an estimate of the number of specimens necessary for the experimental strength determination. The experimental strength determination comprises measurements on components under simulated operation conditions (e.g. a tube section) as well as on small specimens of identical material in the 4-point bending test. The results shows, that a small number of tests is sufficient to determine mean strength directly on components, but a big number of specimens is needed to determine the strength for a technologically significant low fracture probability. With acceptable effort this objective can be achieved only using small specimens.

27755 **(N—88-15257) Imaging subtle microstructural variations in ceramics with precision ultrasonic velocity and attenuation measurements.** Generazio, E.R.; Roth, D.J.; Baaklini, G.Y. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1987. 11p. (NASA-TM—100129; E—3710; NAS—1.15:100129; CONF-870691—). NTIS, PC A03/MF A01.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

Acoustic images of a silicon carbide ceramic disk were obtained using a precision scanning contact pulse echo technique. Phase and cross-correlation velocity, and attenuation maps were used to form color images of microstructural variations. These acoustic images reveal microstructural variations not observable with x-ray radiography.

27756 **(PB—88-146394/XAB) Electronic structure of Y-Ba-Cu oxides and fluorides.** Temmerman, W.M.; Szotek, Z.; Durham, P.J.; Stocks, G.M.; Sterne, P.A. (Daresbury Lab. (UK)). Sep 1987. 12p. (DL/SCI/P—562T). NTIS, PC E03/MF E03.

The authors calculated the electronic structure of the superconducting $YBa_2Cu_3O_7$ and the non-superconducting $YBa_2Cu_3F_2O_6$ compounds. They find that, on reducing the oxygen content the Cu in the O-Cu-O linear chains becomes insulating. They also studied some hypothetical $YBa_2Cu_3F_2O_6$ systems with F_2 added to examine the effect of fluorine on the Cu-O_5 pyramids and the O-Cu-O chains.

27757 Formation of $YBa_2Cu_3O_7$ superconducting films by ion implantation. Nastasi, M.; Tesmer, J.R.; Hollander, M.G.; Smith, J.F.; Maggiore, C.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **52**: No. 20, 1729-1731(16 May 1988).

We have fabricated superconducting thin films by ion implanting Y into a base material formed by the coevaporation of BaF_2 and Cu. The implantations were carried out at 77 K and resulted in the formation of an amorphous Y-Ba-Cu-F surface layer. Oxygen annealing with the addition of water vapor renders the base material insulating with a room-temperature resistance of 10^5 Ω. An identical annealing treatment on the Y-implanted material produces a superconductor with an onset temperature of 85 K.

27758 Generation of vertical Bloch lines in ion-implanted (111) garnet films. Fernandez-de-Castro, J.J.; Friedlaender, F.J. (School of Electrical Engineering, Purdue University, West Lafayette, Indiana 47907). *Journal of Applied Physics;* **63**: No. 8, 3165-3167(15 Apr 1988).

In the rotating gradient experiment (RGE), a magnetic bubble moves continuously in a circular trajectory, and vertical Bloch lines (VBL) are generated from Bloch curves (BC) when field gradients are increased. Three samples, from the same wafer, are studied by means of the RGE. Two of the three samples have been ion implanted at 200 keV with Ne^+ at 1 and 2 x 10^{14} atoms/cm^2. The dynamic transitions and the bubble states, winding number (S), and the dimensionless momentum (p) are investigated for the implanted and unimplanted samples. Changes in S and p are observed in the unimplanted sample, but only p can be modified in the implanted films. The experimental data gives evidence that the value of p always increases by two after each of the dynamic transitions in the implanted samples. Also, changes (Δp) in the value of p, in the intermediate region between transitions, are a result of an increase in the size of the BCs. The increase in resistance to growth and punch-through of BCs, and to translation of VBLs is found to cause the velocity and Δp of implanted films to increase further in the region between transitions. The bubble trajectories in the unimplanted and lightly implanted samples form circles for all bubble states observed. However, the heavily implanted sample exhibits an elliptical trajectory because the bubble translational velocity changes with position as a result of an in-plane anisotropy. The ratio of the major to the minor axes is sometimes larger than 2.

27759 Neutron inelastic experiments on actinide dioxides: Search for crystal-field levels in NpO_2. Kern, S.; Morris, J.; Loong, C.K.; Goodman, G.L.; Lander, G.H.; Cort, B. (Department of Physics, Colorado State University, Fort Collins, Colorado 80523). *Journal of Applied Physics;* **63**: No. 8, 3598-3600(15 Apr 1988).

Early experiments at the pulsed neutron source at Argonne National Laboratory (ANL) showed that it was possible to observe crystal-field (CF) levels at energy transfers above 150 meV in UO_2. More recent investigations at the UK pulsed source at Rutherford Laboratory have improved the resolution and seen a series of well-resolved peaks. Based on these measurements the CF parameters are $V_4 = -130$ meV and $V_6 = +30$ meV. Since these parameters should be independent of the precise An ion, there is interest in looking at the tetravalent oxides UO_2, NpO_2, and PuO_2. We have now performed experiments at ANL on NpO_2 at temperatures between 15 and 200 K. We find no sharp peak in the excitation spectrum up to energy transfers of about 250 meV. This result is contrary to the expected strong transition at about 53 meV using the above CF parameters in a complete intermediate coupling calculation. The observed phonon spectrum of NpO_2, in comparison with that of ThO_2, shows larger widths in all of the three vibrational bands above ~30 meV, which may indicate strong interaction between CF levels with optic phonons in NpO_2.

27760 Antiferromagnetism in the high-T/sub c/ related compounds (invited). Sinha, S.K.; Moncton, D.E.; Johnston, D.C.; Vaknin, D.; Shirane, G.; Stassis, C. (Exxon Research and Engineering Company, Annandale, New Jersey 08801). *Journal of Applied Physics;* **63**: No. 8, 4015-4018(15 Apr 1988).

Magnetic susceptibility measurements on La_2CuO/sub 4-// sub y/ have revealed maxima in temperature indicative of antiferromagnetic ordering. Powder diffraction measurements have demonstrated the existence of superlattice peaks at temperatures below those corresponding to the susceptibility maxima, and polarized neutron measurements have confirmed that the peaks are indeed of magnetic origin. The deduced antiferromagnetic structure in the orthorhombic (Cmca) phase of La_2CuO/sub 4-//sub y/ consists of ferromagnetic sheets of Cu atoms in the b-c plane which are alternating in sign along the a axis [100]. The moment is parallel to the c axis. The Neel temperature is extremely sensitive to the oxygen deficiency y and decreases rapidly to zero as y goes from 0.03 to 0. The saturated moment is ≃0.4 μ/sub B//Cu atom for samples with the highest T/sub N/ (290 K). Antiferromagnetic spin fluctuations have also been observed by polarized neutron scattering in the paramagnetic phase above T/sub N/. Recent results obtained on magnetic ordering in the YBa_2Cu_3O/sub 6-//sub y/ family of compounds are also discussed, together with the possible implications for novel superconductivity mechanisms.

27761 X-ray absorption spectroscopy studies of high-T/sub c/ superconductors. Jeon, Y.; Lu, F.; Jhans, H.; Shaheen, S.A.; Croft, M.; Ansari, P.H. (Department of Physics, Rutgers University, Piscataway, New Jersey 08855-0849). *Journal of Applied Physics;* **63**: No. 8, 4190-4192(15 Apr 1988).

X-ray absorption spectroscopy measurements on rare-earth (R) and Ba sites in the new superconducting oxides and in binary rare-earth oxides are discussed. All of the near-edge spectra appear to manifest a continuum resonance feature whose energy is quantitatively well correlated with the R—O and Ba—O bond lengths. Evidence supporting a second such feature related to the R/Ba interatomic distance is also presented. Finally, simultaneous consideration of both of these features appears consistent with the inverse square-law expectation for the interatomic distance dependence of the energies of these spectra features.

27762 Magnetic field dependence of the cyclotron effective mass in the Kondo lattice CeB_6. Joss, W.; van Ruitenbeek, J.M.; Crabtree, G.W.; Tholence, J.L.; van Deursen, A.P.J.; Fisk, Z. (Max Planck Institut fuer Festkoerperforschung, Hochfeld Magnetlabor, B. P. 166X, F-38042 Grenoble Cedex, France). *Journal of Applied Physics;* **63**: No. 8, 3893-3895(15 Apr 1988).

We report the first observation of a field-dependent mass in a hybridizing f-electron system. CeB_6 is an ordered moment heavy fermion system with an electronic specific heat coefficient γ of order 225—300 mJ/mole K^2. Using the de Haas—van Alphen effect at temperatures as low as 60 mK in steady magnetic fields as large as 22 T, we observe a cyclotron orbit of frequency 8680 T for fields along the [100] direction. The mass of this orbit was measured at eight fixed fields and found to decrease from 18m/sub e/ to 8m/sub e/ as the field increases from 12 to 22 T. The observed Fermi surface is very similar to that of LaB_6, indicating that the f-electrons are largely local rather than itinerant in CeB_6, a picture confirmed by bandstructure calculations. The observed field dependence of the cyclotron mass is consistent with the low-energy scale of the system as measured, for example, by the Kondo temperature. Our results are compared with Fermi surface observations in other heavy fermion systems.

27763 Low-field characterization of YBa_2Cu_3O/sub 7-// sub δ/ single crystals. Claus, H.; Crabtree, G.W.; Liu, J.Z.; Kwok, W.K.; Umezawa, A. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **63**: No. 8, 4170-4172(15 Apr 1988).

Low-field magnetization measurements in fields from 0 to 100 G at temperatures from 4.2 to 100 K on single crystals of YBa_2Cu_3O/sub 7-//sub δ/ are presented. The crystals have sharp inductive transitions at 91.5 K, occasionally with additional structure suggesting a second phase with a lower T/sub c/ . For all crystals in all directions the Meissner effect is a small fraction of the shielding effect. Low-field measurements of H/sub c/$_2$ within 1 K of T/sub c/ show a linear temperature dependence with a slope of 80 G/K, much smaller than observed at higher field.

27764 Constricted diamagnetic hysteresis loops observed for the high T/sub c/ superconductors. Atzmony, U.; Shull, R.D.; Chiang, C.K.; Swartzendruber, L.J.; Bennett, L.H.; Watson, R.E. (National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Applied Physics;* 63: No. 8, 4179-4181(15 Apr 1988).

Magnetic hysteresis loops, ac susceptibility, and resistivity measurements have been made on a Ba2 YCu3 O/sub 7-//sub x/-type high- T/sub c/ superconductor. The shape of the hysteresis loops well below T/sub c/ are reminiscent of constricted hysteresis loops observed in certain ferromagnetic materials which are usually associated with magnetic aftereffects. Similar dynamic effects, with a time constant on the order of 10 s at 40 K, are shown to be present in the superconducting material. This dynamic magnetic viscosity effect is in addition to the flux creep observed for longer time periods.

27765 Correlation between electronic states of O, Cu, and Ba in several high-T/sub c/ superconductors. Horn, S.; Cai, J.; Shaheen, S.A.; Croft, M.; Chang, C.L.; den Boer, M.L. (Department of Physics, New York University, 4 Washington Place, New York, New York 10003). *Journal of Applied Physics;* 63: No. 8, 4193-4195(15 Apr 1988).

X-ray photoemission measurements of Y-, Sm-, Eu-, and Yb-based high-temperature superconductors show a clear correlation between Cu 2p satellite features, which previous work has shown are associated with materials which exhibit superconductivity, and a high-binding-energy peak in the O 1s spectrum. In samples with varying oxygen content the intensity of the Cu 2p satellites changes, reflecting the Cu valence which varies between 1+ and 2+. The high-binding-energy O peak appears to track the Cu valence. This high-binding-energy peak may be indicative of the presence of O 2p holes, suggested in some models as necessary for superconductivity. The Ba 3d peak position also changes systematically with the Cu valence.

27766 Magnetic behavior of Y-Ba-Cu-O superconductors prepared under different oxygen anneals. Datta, T.; Almasan, C.; Estrada, J.; Violet, C.E.; Gubser, D.U.; Wolf, S.A. (University of South Carolina, Columbia, South Carolina 29208). *Journal of Applied Physics;* 63: No. 8, 4204-4206(15 Apr 1988).

In our study of three YBa2 Cu3 oxides prepared with different oxygen anneals, we observed that the temperature derivative of the magnetization or susceptibility chi(T) of these high-T/sub c/ superconductors has a maximum at approximately the transition temperature, T/sub c/ . This temperature as estimated by the peak value of (partialchi/partialT)/sub H/ , ranged between 55 and 65 K. The most oxygen-poor sample showed the lowest T/sub c/ and the most oxygen-rich sample showed the highest T/sub c/ . In the subcritical region, a novel irreversibility is observed in the field-cooled warm-up and cool-down behaviors.

3606 Other Materials

REFER ALSO TO CITATION(S) 27447, 27480, 27502, 27556, 27651, 27715, 27748, 27874, 27930, 27967, 27968, 27970, 27975, 28177

27767 (AD-A—187999/8/XAB) Study of electronic transport and breakdown in thin insulating films. Semi-annual technical report No. 9. Johnson, W.C. (Princeton Univ., NJ (USA). Dept. of Electrical Engineering and Computer Science). 1 Jun 1980. 44p. NTIS, PC A03/MF A01.

Recent progress is reported in an ongoing program of studies of high-field and radiation effect in thin insulating films on semiconducting substrates. The investigations reported here include the generation of interface states in the Si-SiO_2 system by the photoinjection of electrons and by Fowler-Nordheim tunneling of electrons, and a study of radiation-induced interface states.

27768 (AD-A—188282/8/XAB) Micro-mechanisms of deformation in SiC/Al composites. Final report, 1 August 1984-31 August 1987. Papazian, J.M.; Levy, A.; Adler, P.N. (Grumman Corp., Bethpage, NY (USA). Corporate Research Center). 31 Aug 1987. 37p. (RE—738). NTIS, PC A03/MF A01.

The deformation mechanisms of aluminum-matrix composites containing SiC whiskers or particulate were investigated both experimentally and analytically to determine factors critical to their mechanical behavior. The effects of the discontinuous SiC on age-hardening behavior; the influence of silicon carbide morphology; interactions between SiC dispersoids and matrix precipitates, and dislocations were considered. Two matrix alloys were investigated: a solution-hardened 5456 alloy containing no matrix precipitates; and a 2124 alloy that could be aged and cold worked to contain different matrix-precipitate microstructures and dislocation contents. The influence of SiC on the age-hardening behavior of 2124 was evaluated using differential scanning calorimetry. The precipitation sequence in the composites was found to be very similar to that in SiC-free material prepared by either powder or ingot metallurgy. Both whiskers and particulate increased the quench sensitivity of 2124 by causing the precipitation of GPB zones and S' during the quench from solution heat treatment. This effect was independent of quench rate.

27769 (AD-A—188526/8/XAB) Microdesigning of light-weight/high-strength ceramic materials. Final technical report, 30 September 1983-30 November 1986. Aksay, I.A. (Washington Univ., Seattle (USA). Dept. of Materials Science and Engineering). 30 Aug 1987. 307p. NTIS, PC A14/MF A01.

The overall objective of this program was concerned primarily with processing and characterization of low-density, high-strength ceramic-matrix composites for structural applications. In order to achieve this goal, three main task areas were emphasized: (i) fundamental studies in processing, (ii) processing of ceramic/metal composites, and (iii) theoretical studies. The work in the first task area consisted of experimental studies on phase transitions in colloidal systems and microstructure/nanostructure evolution during sintering. These studies dealt with the dispersion, consolidation, and sintering of ceramic powders and ceramic-forming gels, in an effort to provide a fundamental understanding of key processing parameters that affect the microstructure of the material. The key contribution of these studies was recognition of the fact that colloidally consolidated particle compacts display hierarchical clustering due to multiple-site nucleation and growth of particle clusters. Consequently, such hierarchically clustered structures display a multimodal void-size distribution. The work in the second task area saw development of techniques for processing a new class of particulate based on low-density ceramic/metal composites composed of boron carbide/aluminum and aluminum diboride/aluminum composite materials. These materials exhibited high fracture toughness high fracture strength and high hardness.

27770 (AD-A—188559/9/XAB) Plasma joining of metal-matrix composites. Interim report, February-May 1987. Reynolds, G.H.; Yang, L. (MSNW, Inc., San Marcos, CA (USA)). Oct 1987. 7p. NTIS, PC A02/MF A01.

See also AD-A184 828 and AD-A181 056.

Aluminum zirconium silicon carbide and aluminum titanium silicon carbide composite-powder filler metals prepared for butt welding of Al/SiC composite base plates to be used for weldment mechanical-property studies are described. Two composite powder filler metal compositions were prepared in moderate quantities for use in preparation of larger scale butt welds in A1/SiC composite base plates. Each composition was designed to provide reactive metal concentrations that have been used previously, while maintaining a two-phase (A1(Zr) - $A1_3Zr$ and A1(Ti) - $A1_3Ti$, respectively) matrix microstructure. This represents an attempt to maintain a reasonably ductile matrix phase while providing sufficient reactive metal concentration for suppression of interfacial $A1_4C_3$ formation during plasma processing.

27771 (AD-A—188649/8/XAB) Evaluation of filament-reinforced electrocomposites (reinforcement of electroforms with continuous filaments). Final report. Greco, V.P. (Army Armament Research and Development Command, Watervliet, NY (USA). Benet Weapons Lab.). Oct 1987. 34p. (ARCCB-TR—87029). NTIS, PC A03/MF A01.

From a review of the literature, an updated evaluation of filament-reinforced electrocomposites is given and the benefits and limitations of the process are summarized. The successful results

and properties obtained with electrocomposites from earlier studies are also presented and problems encountered are discussed. Process changes for improving the quality and strength of electrocomposites are proposed.

27772 **(AD-A—188659/7/XAB) Strain rate effects for concrete and fiber-reinforced concrete subjected to impact loading. Final report, September 1982-August 1987.** Shah, S.P. (Northwestern Univ., Evanston, IL (USA). Center for Concrete and Geomaterials). Oct 1987. 84p. NTIS, PC A05/MF A01.

Despite it's extensive use, low tensile strength has been recognized as one of the major drawbacks of concrete. Although one has learned to avoid exposing concrete structures to adverse static tensile loads, these structures cannot be shielded from short duration dynamic tensile loads. Such loads originate from sources such as impact from missiles and projectiles, wind gusts, earthquakes and machine vibrations. In addition, modern computer-aided analysis and use of concrete for special structures such as reactor containment vessels, missile storage silos and fall-out shelters, has led to a growing interest in the cracking behavior of concrete. Experimental results indicate that the fracture strength and cracking behavior of concrete are affected by the rate of loading. To accurately predict the structural response under impact conditions, the knowledge of behavior of concrete at high rates of loading is essential. Using a two degree of freedom model guidelines were developed for designing an impact test setup, thus enabling one to conduct impact tests free of adverse inertial effects. Based on these guidelines, the author has developed an instrumented modified Charpy impact testing system. This experimental test setup was used to obtain basic information such as load-deflection relationship, fracture toughness, crack velocity (measured using Krak Gages), and load-strain history during an impact fracture event of plain concrete and SFRC.

27773 **(INIS-mf—11647) Calculation of the electronic structure of deep traps in silicon.** Beeler, F. (Stuttgart Univ. (Germany, F.R.). Fakultaet 12 - Physik). 12 Feb 1986. 285p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88753251/JAW.

In the present thesis the LMTO-ASA Green's function method is applied to a real system (Silicon crystal with trap) for the first time. The electronic structure of the point defects for H and He on the tetrahedral (T/sub p/) sites in Si shows agreement with experimental results. Moreover, the theory can distinguish the two T/sub p/ sites for S, Se and Te. Then the diffusion of the chalcogen atoms in Si is investigated and the electronic structure of the 3d-transition element ions in Silicon is examined. (BHO).

27774 **(PB—88-163183/XAB) Exposure assessment of acrylates/methacrylates in radiation-cured applications.** (PEI Associates, Inc., Cincinnati, OH (USA)). 25 Sep 1987. 108p. NTIS, PC A06/MF A01.

Occupational exposures to radiation-cured acrylates/methacrylates during their processing and use in coatings, inks, and adhesives were evaluated in 12 walk-through surveys at formulator and applicator sites. Inhalation and dermal-exposure routes were studied. According to the authors, the basic process used to formulate coatings, inks, and adhesives consists of blending raw materials in closed mixing vessels using local exhaust ventilation in the form of elephant trunks at vessel charging and packaging locations. Application methods surveyed included reverse-roll coaters, direct roll coaters, curtain/rain coaters, laminators, pneumatic injection, spray guns, and manual application. At the sites surveyed, the number of workers potentially exposed at each site ranged from two to 142. Process operators at applicator sites had the greatest potential for dermal exposure. Generally, the potential for inhalation exposure was low due to low volatility of the multifunctional acrylates/methacrylates used in the formulations. No reliable air-monitoring data were available at any site. Respirator use was limited and sporadic.

27775 **(PB—88-859475/XAB) Plastics and elastomers: space applications. January 1977-February 1988 (Citations from the Rubber and Plastics Research Association data base). Report for January 1977-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 164p. NTIS PC N01/MF N01.

Supersedes PB—87-853487.

This bibliography contains citations concerning thermoplastic and thermosetting resins used for space environments. Among the properties examined for selected polymers are ultraviolet-light sensitivity, radiation resistivity, sensitivity to extreme temperatures, adhesion qualities, strength, and insulation value. Fiber-reinforced plastics, nylon, vinyl, cellular plastics, epoxy resin, PTFE, and elastomers are among the polymers and adhesive resins described with reference to manufacturers, tradenames, marketing trends, performance results, and specific applications. (This updated bibliography contains 368 citations, 76 of which are new entries to the previous edition.)

27776 **(PB—88-859962/XAB) Boron reinforced composites. May 1980-March 1988 (Citations from the NTIS data base). Report for May 1980-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 97p. NTIS PC N01/MF N01.

Supersedes PB—87-855896.

This bibliography contains citations concerning the utilization of boron fibers and compounds as a reinforcing material in composites. Topics include testing methods, fabrication, and structural and mechanical properties characterizations. Degradation studies and crack initiation and propagation are also included. (This updated bibliography contains 178 citations, 22 of which are new entries to the previous edition.)

27777 **(PB—88-860556/XAB) Photopolymerization. January 1970-March 1988 (Citations from the Engineering Index data base). Report for January 1970-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 144p. NTIS PC N01/MF N01.

Supersedes PB—87-850368.

This bibliography contains citations concerning photopolymerization of various materials. Among the materials examined are catalyzed and uncatalyzed polymers, monomers, and composite materials. Photopolymerization for thermal-transfer printing on textiles, elimination of oxygen in photopolymerization processes, photopolymerization energy requirements, and calorimetric analysis of photopolymerizations are included. Photopolymerization processes used in the manufacture of laser videodiscs are presented. (This updated bibliography contains 328 citations, 50 of which are new entries to the previous edition.)

27778 **(UCRL—96108) Synthesis and characterization of chemical analogs of L-arginine phosphate.** Monaco, S.B.;Davis, L.D.;Velsko, S.P.;Wang, F.T.;Eimerl, D.;Zalkin, A. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 8p. (CONF-870799—6).

From American conference on crystal growth; Monterey, CA, USA (13 Jul 1987).

L-arginine phosphate is a promising new material for harmonic generation of the Nd:YAG fundamental wavelength, 1064 nm. The synthesis of 24 other salts of L-arginine was attempted and millimeter size crystals of 9 of these were obtained. These were analyzed for crystal structure and chemical composition and the linear and nonlinear optical properties measured. The compounds were all optically biaxial and several gave second harmonic signals greater than quartz. Phasematching has been observed in four of the crystals to date. 3 refs., 2 tabs.

27779 **Optical and transmission-electron-microscopy characterization of metal precipitates in doped thermochemically reduced magnesium oxide.** Ballesteros, C.; Gonzalez, R.; Chen, Y. (Departamento de Fisica del Estado Solido, Facultad de Ciencias Fisicas, Universidad Complutense, 28040 Madrid, Spain). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 14, 8008-8014(15 May 1988).

MgO crystals doped with Co, Cu, and V were thermochemically reduced at high temperatures. Changes in coloration were observed in all these crystals due to broad optical extinction bands in the visible region. These bands are impurity related. Analytical transmission-electron-microscopy techniques indicated the presence of metallic precipitates consisting of Co in the Co-doped sample, Cu with some precipitates of Fe in the Cu-doped sample, and a V-

Fe-Cr alloy in the V-doped sample. Microdiffraction patterns indicated that the Co precipitates possessed the fcc (a_0 = 3.54 A) crystal structure and V-Fe-Cr alloy precipitates showed a bcc (a_0 = 2.89 A) crystal structure.

27780 **First-principles calculation of highly asymmetric structure in scanning-tunneling-microscopy images of graphite.** Tomanek, D.; Louie, S.G. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **37**: No. 14, 8327-8336(15 May 1988).

Using a first-principles calculation, we have computed the charge density for states near E/sub F/ that is related to the current density observable in scanning-tunneling-microscopy experiments for surfaces of hexagonal, rhombohedral, and a model stage-1 intercalated graphite. In hexagonal and rhombohedral graphite, the tunneling current is predicted to be considerably smaller at surface atomic sites which have nearest neighbors directly below them than at sites with no such neighbors. This asymmetry is explained by the particular symmetry of the wave functions at the Fermi surface of graphite near K-bar in the surface Brillouin zone. The calculated asymmetry is nearly independent of the polarity and decreases with increasing magnitude of the bias voltage. Our results show that no asymmetry is expected on surfaces of stage-1 AA stacked intercalated graphite. The dependence of the asymmetry on the tip-to-surface separation has also been evaluated using a tight-binding model for different bias voltages. For the surface of hexagonal graphite, our predictions have been confirmed by recent experiments.

27781 **Evidence for the intrinsic nature of light-induced defects in undoped a-Si:H.** Skumanich, A.; Amer, N.M. (IBM Almaden Research Center, 650 Harry Road, San Jose, California 95120-6099). *Physical Review [Section] B: Condensed Matter;* **37**: No. 14, 8465-8467(15 May 1988).

Absorption measurements using photothermal deflection spectroscopy were performed on a series of a-Si:H films with various levels of typical impurities to investigate their role in light-induced defect formation. It was found that at low concentrations (<5 at. %) the light-induced defect creation rate is independent of impurity concentration for oxygen, nitrogen, and carbon, which agrees with electron-spin-resonance results.

27782 **Breathing-mode lattice relaxation associated with the vacancy and phosphorous-vacancy-pair (E-center) defect in silicon.** Samara, G.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **37**: No. 14, 8523-8526(15 May 1988).

Comparison of published theoretical results on the lattice volume (breathing-mode) relaxation associated with the formation of the vacancy in silicon with the experimentally determined relaxation associated with the closely related phosphorus-vacancy-pair (or E-center) defect is used to provide a badly needed calibration on both the theoretical and experimental methods and leads to definitive conclusions about the sign (outward) and magnitude (~5% of the Si-Si bond length) of this relaxation for the neutral charge states of both defects. The charge-state dependence of this relaxation is also discussed.

27783 **Acoustic-phonon scattering in modulation-doped heterostructures.** Walukiewicz, W. (Center for Advanced Materials, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **37**: No. 14, 8530-8533(15 May 1988).

We use recently determined values of conduction- and valence-band edge deformation potentials to analyze two-dimensional electron and hole mobilities in GaAs/Al/sub x/Ga/sub 1-//sub x/As modulation-doped heterostructures. Contrary to the commonly accepted view, it is shown that a consistent description of low-temperature mobility can be given only if the short-range deformation potential scattering is not screened by free carriers.

27784 **Comment on "New evidence of small lattice relaxation for the DX center in Al/sub x/Ga/sub 1-//sub x/As" [Appl. Phys. Lett. 51, 1358 (1987)].** Yu, P.Y.; Li, M. (Department of Physics, University of California, Berkeley, California 94720, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* **52**: No. 19, 1645-1645(9 May 1988). Contract AC03-76SF00098.

Deep level transient spectroscopy has been performed on the DX center in the Ga/sub 0.65/Al/sub 0.35/As:Te as a function of pressure. The lattice relaxation we observed showed that the results of Talwar et al. (small lattice relaxation) are inconsistent and inconclusive. Our results significantly weaken their evidence in favor of small lattice relaxation. (AIP)

27785 **Elimination of interface defects in mismatched epilayers by a reduction in growth area.** Fitzgerald, E.A.; Kirchner, P.D.; Proano, R.; Pettit, G.D.; Woodall, J.M.; Ast, D.G. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14853). *Applied Physics Letters;* **52**: No. 18, 1496-1498(2 May 1988).

We have eliminated interface defects from the mismatched In/sub 0.05/Ga/sub 0.95/As/ (001)GaAs interface by controlling the size of the growth area. 2-μm-high pillars with different lateral shapes and dimensions were defined within the GaAs substrate before the molecular beam epitaxial growth of 3500 A of In/sub 0.05/Ga/sub 0.95/As, greater than four times the critical thickness. On the pillars, the linear density of misfit dislocations was reduced from >5000 dislocations/cm for large (several hundred μm lateral dimensions) growth areas to nearly zero for 25 μm lateral dimensions. The dislocation density remains less than 800 dislocations/cm for lateral dimensions up to 100 μm. We find that there is also a decrease in dislocation density in narrow channels between the pillars; therefore, the pillars also block the glide of misfit dislocations.

27786 **Aging effects in bulk and fiber TlBr-TlI.** Wysocki, J.A.; Wilson, R.G.; Standlee, A.G.; Pastor, A.C.; Schwartz, R.N.; Williams, A.R.; Lei, G.; Kevan, L. (Hughes Research Laboratories, 3011 Malibu Canyon Road, Malibu, California 90265). *Journal of Applied Physics;* **63**: No. 9, 4365-4371(1 May 1988).

A study of optical aging in bulk and extruded fibers of thallium bromo-iodide (TlBr-TlI) is presented. A variety of techniques including secondary ion mass spectrometry (SIMS), powder neutron and x-ray diffraction, infrared spectroscopy, and electron paramagnetic resonance (EPR) spectroscopy are used to probe the chemical and structural properties of both pristine and aged material. High concentration levels of a hydrogen bearing impurity have been detected by SIMS and neutron scattering in aged TlBr-TlI, and have been shown to be localized in the surface layers of fibers as well as bulk samples. We present EPR evidence which indicates that the hydrogen bearing impurity is water.

27787 **Resistivity of linear scratches in doped (100) n-type single-crystal silicon.** Danyluk, S.; Lee, S.; Ahn, J.; Kahn, A. (University of Illinois at Chicago, Department of Civil Engineering, Mechanics and Metallurgy, Chicago, Illinois 60680). *Journal of Applied Physics;* **63**: No. 9, 4568-4571(1 May 1988).

Four-point probe measurements have been made on (100) n-type Czochralski silicon wafers of initial resistivities 0.016, 0.96, and 3.35 Ω cm. The probe tips straddled linear single scratches formed by a Vickers pyramid diamond. The diamond was dead-loaded with 0.25 N, and the scratches were made in a laboratory air environment with a relative humidity of 50%, as the silicon wafer was held at various elevated temperatures. The measurements show that the relative change in resistivity increases with temperature up to an optimum temperature, after which the resistivity decreases. The temperature at which the maximum occurs and at which the relative change in resistivity occurs depends on the initial resistivity of the wafers; the temperature at which the maximum change in relative resistivity occurs is 200 °C for the 0.016- and 0.96-Ω cm wafers and 250 °C for the 3.35-Ω cm wafer. The relative change between the undamaged wafer resistivity and the resistivity including the scratches for these same samples was 4%, 7%, and 9%. Scanning

electron micrographs of the scratches showed that the scratch morphology also depended on the temperature; as the temperature is increased, the grooves become shallow and display evidence of ploughing. An analysis of the four-point probe geometry shows that the voltage in the four-point probe measurement depends on the size and the conductivity of the damage surrounding the scratches.

27788 **Examination of double positioning boundaries and interface misfit in beta-SiC films on alpha-SiC substrates.** Kong, H.S.; Jiang, B.L.; Glass, J.T.; Rozgonyi, G.A.; More, K.L. (Department of Materials Science and Engineering, North Carolina State University, Box 7907, Raleigh, North Carolina 27695-7907). *Journal of Applied Physics;* 63: No. 8, 2645-2650(15 Apr 1988).

Beta-SiC thin films epitaxially grown on 6H-SiC (0001) substrates were examined via scanning-reflection x-ray topography (XRT) and x-ray rocking curve analysis. The lattice misfit between the (111) plane of the β-SiC epitaxial layer and the (0001) plane of the 6H-SiC substrate was determined to be 7.6×10^{-4}. Boundaries separating regions of the β-SiC film rotated from each other by 60° were observed and identified by XRT as double positioning boundaries (DPBs), which are a special type of twin boundary. The XRT maps showed that the mosaic structure examined via optical microscopy was also caused by the DPBs. Finally, many stacking faults were generated at the boundaries as revealed by plan-view transmission electron microscopy, indicating the high internal energy of these DPBs. The formation mechanisms of the DPBs is also discussed.

27789 **Neutron scattering investigation of a quasi-two-dimensional planar ferromagnet.** Wiesler, D.G.; Zabel, H. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 W. Green Street, Urbana, Illinois 61801). *Journal of Applied Physics;* 63: No. 8, 3554-3556(15 Apr 1988).

The magnetic ordering of stage-2 $CoCl_2$-graphite intercalation compound has been investigated by neutron diffraction. This compound is a layered structure, with ferromagnetic coupling between xy-type spins within the same layer and a much weaker antiferromagnetic coupling between successive layers. The interplanar coupling is sufficiently weak that the ordering occurs in two steps, leaving a temperature window between T/sub l/≃8.8 K and T/sub u/≃9.4 K where the ordering is purely two dimensional. Below T/sub l/ the spins become weakly correlated along the c axis, but this correlation never grows beyond two magnetic layers. We have measured the static spin correlation function by neutron scattering. At all relevant temperatures the scattering is markedly two dimensional and consists of two parts: a short-range order term with maximum correlation length and intensity at T/sub u/, and a sharp Bragg-like ridge of constant width, which vanishes above T/sub u/ and relates to either long-range order or a power-law decay of the order parameter. Results will be analyzed in light of current theories, in particular, of the vortex binding mechanism proposed by Kosterlitz and Thouless.

27790 **Magnetic structure of UCu_2Si_2 and U(Cu/sub 0.75/Mn/sub 0.25/)$_2Si_2$.** Giorgi, A.L.; Lawson, A.C.; Goldstone, J.A.; Volin, K.J.; Jorgensen, J.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* 63: No. 8, 3604-3605(15 Apr 1988). Contract W-31-109-ENG-38.

The replacement of Cu by Mn in UCu_2Si_2 causes surprisingly large increases in both the Curie temperature and the coercivity of this ferromagnetic material. We have performed neutron powder diffraction experiments on a series of U(Cu,Mn)$_2Si_2$ alloys and found that UCu_2Si_2 is a simple ferromagnet with a magnetic moment of 2.0(1)μ/sub B/ on the U atoms pointing along the crystallographic c axis of the tetragonal unit cell. The alloy U(Cu/sub 0.75/Mn/sub 0.25/)$_2Si_2$ is also a ferromagnet with moments on both U and Mn pointing in the c direction. The moment on the U atoms is 1.7(1)μ/sub B/, and the average moment on the (Cu,Mn) site is 0.16(5)μ/sub B/. No indication of chemical ordering on the (Cu,Mn) site was detected.

27791 **Effective electron interactions due to virtual charge and spin excitations in an extended Hubbard model for Cu-O superconductors.** Schuettler, H.; Fedro, A.J. (Center for Simulational Physics, Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). *Journal of Applied Physics;* 63: No. 8, 4209-4211(15 Apr 1988).

We have studied the effect of virtual Co-O charge and spin fluctuations in the perovskite high-T/sub c/ materials by applying a strong coupling expansion to an extended Hubbard model with hybridized Cu d orbitals and O p orbitals. Results for the charge and spin fluctuation-mediated effective interactions are derived and discussed.

27792 **Piezoelectric effects in strained-layer superlattices.** Smith, D.L.; Mailhiot, C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* 63: No. 8, 2717-2719(15 Apr 1988).

Because zinc-blende structure semiconductors are piezoelectric, polarization fields can be generated in the constituent materials of strained-layer superlattices by lattice-mismatch-induced strain. The orientation of the polarization fields depends on the superlattice growth axis. Because one of the constituent layers of the superlattice is in biaxial tension and the other is in biaxial compression, the sign of the polarization field is opposite in the two constituent layers making up the superlattice period. Thus, sheets of divergence of polarization occur at the interface for a longitudinal induced polarization and sheets of curl of polarization occur at the interface for a transverse induced polarization. For a [111] growth axis, the induced polarization is purely longitudinal; for a [110] growth axis, the induced polarization is purely transverse. For a general growth axis the induced polarization has both longitudinal and transverse components. The sheets of divergence of polarization generate internal electric fields and the sheets of curl of polarization generate internal electric displacement fields. The internal electric fields are always purely longitudinal and the internal electric displacement fields are always purely transverse. The magnitude of these fields can be very large.

27793 **Hole trapping in oxides grown by rapid thermal processing.** Seager, C.H.; Schubert, W.K. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* 63: No. 8, 2869-2871(15 Apr 1988). Contract AC04-76DP00789.

Thin, high-quality SiO_2 films have been grown by rapid thermal oxidation techniques and subjected to a variety of post-oxidation annealing protocols. The hole trapping rates in these films have been measured by subjecting them to x rays and Fowler—Nordheim tunneling injection. The density of hole traps is seen to depend crucially on the temperature and oxygen content of the post-oxidation annealing environment. These results support recent suggestions that an oxygen deficient defect near the Si/SiO_2 interface is the primary hole trap in MOS (metal-oxide-semiconductor) devices.

27794 **Quest for a polymeric ferromagnet: A new polymorph of 1,4-bis(2,2,6,6-tetramethyl-4-oxy-4-piperidyl-1-oxy)butadiyne (invited).** Miller, J.S.; Calabrese, J.C.; Glatzhofer, D.T.; Epstein, A.J. (Central Research and Development, E. I. du Pont de Nemours and Co., Inc., Experimental Station E328, Wilmington, Delaware 19898). *Journal of Applied Physics;* 63: No. 8, 2949-2951(15 Apr 1988).

A new polymorph of 1,4-bis(2,2,6,6-tetramethyl-4-oxy-4-piperidyl-1-oxy)butadiyne has been prepared and characterized by x-ray diffraction, infrared and Raman spectroscopies, and magnetic susceptibility. Unlike the Pccn-α phase, the β phase belongs to the $Pca2_1$ space group [a = 14.265(1) A, b = 8.079 (3) A, and c = 18.865(2) A, V = 2174.1 A^3, Z = 4, T = -100 °C, R/sub u/ = 4.8%, R/sub w/ = 5.0%). The C 3/4 C, CC—CC, and NO distances are 1.201, 1.391, and 1.293 A, respectively. The only intermolecular interactions are 1.844-A—OH x x x ON hydrogen bonding interactions. The vibrations ν/sub OH,NH/ = 3289, 3070, 3021, ν/sub NO/(IR) = 1341, and ν/sub C 3/4 C/ (Raman) = 2236 cm^{-1} are present. The solid-state motif is that of pleated sheets. UV, electron beam, and γ-ray induced polymerization has not been

achieved; however, thermal treatment turns the crystals black. Thermogravimetric analysis under nitrogen reveals an explosive decomposition at ~140 °C. Between 2 and 300 K the susceptibility obeys the Curie—Weiss expression with Θ = -2.75 K. The effective moment is 2.47μ/sub B/ per molecule which is consistent with two independent S = 1/2 spins per molecule. Upon thermal treatment (17 h at 90 °C) the resultant black material exhibits a reduced Curie—Weiss susceptiblity of 1.12μ/sub B/ and Θ = -2.87 K.

27795 **Spin fluctuations in EuS above T/sub C/: Comparison with asymptotic renormalization-group theory.** Boeni, P.; Shirane, G.; Bohn, H.G.; Zinn, W. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* **63**: No. 8, 3089-3091(15 Apr 1988). Contract AC02-76CH00016.

Constant-energy scans in neutron scattering provide a very sensitive tool for testing theoretical line shapes in detail. In order to verify the predictions of asymptotic renormalization-group theory for isotropic ferromagnets above T/sub C/ we measured the temperature dependence of the paramagnetic scattering from the Heisenberg ferromagnet EuS. The width of the constant-E peaks increases with increasing temperature as predicted. Surprisingly the positions do not scale. The nonuniversal behavior is attributed to the crossover from isotropic to dipolar dynamics.

27796 **Spin dynamics in Zn/sub 1-//sub x/Mn/sub x/Te.** Giebultowicz, T.M.; Rhyne, J.J.; Ching, W.Y.; Huber, D.L.; Furdyna, J.K. (University of Notre Dame, Notre Dame, Indiana 46556 and National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Applied Physics;* **63**: No. 8, 3297-3299(15 Apr 1988).

First results of inelastic neutron scattering studies of quasi-harmonic magnons in Zn/sub 1-//sub x/Mn/sub x/Te are reported. Measurements carried out on two single-crystal samples with x = 0.65 and x = 0.41 at T = 4.2—5.0 K revealed broad excitation modes, which were in excellent agreement with the results of theoretical modelling. Results for x = 0.65 yield J/sub NN/ = (7.9 +- 0.2) K which is the first determination of the nearest-neighbor exchange constant in Zn/sub 1-//sub x/Mn/sub x/Te in this x region. Data taken at higher temperatures showed only weak renormalization of the energy spectra.

27797 **Heavy fermion behavior in CePtSi and CeRuSi.** Rebelsky, L.; Reilly, K.; Horn, S.; Borges, H.; Thompson, J.D.; Willis, J.O.; Aikin, R.; Caspari, R.; Bredl, C.D. (Department of Physics, New York University, New York, New York 10003). *Journal of Applied Physics;* **63**: No. 8, 3405-3407(15 Apr 1988).

We present results of specific heat, electrical resistance, and magnetic susceptibility measurements on the heavy fermion system CePtSi and compare it to CeRuSi. Both compounds show a low-temperature maximum in c/sub p//T, usually associated with the formation of a coherent heavy fermion ground state. An additional feature in c/sub p//T is observed for CePtSi and is attributed to cooperative magnetism, an interpretation confirmed by magnetic measurements. A comparison with other heavy fermion systems, especially stoichiometric and nonstoichiometric $CeCu_5Si_2$, is performed.

27798 **Basis of strong change of hybridization-induced magnetic ordering between CeSb and CeTe.** Kioussis, N.; Cooper, B.R.; Wills, J.M. (Department of Physics, West Virginia University Morgantown, West Virginia 26506). *Journal of Applied Physics;* **63**: No. 8, 3683-3685(15 Apr 1988).

A sharp change in the nature of the magnetic ordering has been observed on going from CeSb to CeTe, both of which have NaCl structures with a small decrease in lattice parameter. This is an interesting example of the way in which hybridization of partially delocalized f electrons with band electrons gives rise to highly unusual magnetic properties which show great chemical sensitivity. In the present paper we apply our previous ab initio treatment of hybridization-induced effects to investigate this striking change in magnetic behavior. We have performed self-consistent warped muffin-tin LMTO band calculations treating the Ce 4f states as resonance states that are constrained to be localized. Compared to CeSb, the anion-derived p bands in CeTe sink well below the Fermi energy, thus strongly changing the band-f hybridization. We have calculated the hybridization dressing of the crystal-field levels and the anisotropic two-ion exchange interaction and compared them with those calculated for CeSb and with experiment. A strong decrease in the two-ion interaction explains the drastic change in observed magnetic behavior between CeSb and CeTe.

27799 **Spin-glass behavior of cubic Tb/sub 0.3/Y/sub 0.7/Ag: A scaling of the thermoremanence.** Said, M.R.; Kouvel, J.S.; Brun, T.O. (Department of Physics, University of Illinois, Chicago, Illinois 60680). *Journal of Applied Physics;* **63**: No. 8, 4340-4342(15 Apr 1988).

Magnetization-versus-temperature (M-vs-T) measurements in a fixed field on cubic pseudobinary Tb/sub 0.3/Y/sub 0.7/Ag show that M for increasing and then decreasing T bifurcates at the antiferromagnetic Neel point (T/sub N/ = 36 K), where M is maximum. The resulting thermoremanence (M/sub R/), which decays very slowly with time, diminishes with increasing T and vanishes at T/sub N/. Thus, the long-range antiferromagnetism appears to coexist with spin-glass ordering. Measurements of M/sub R/ with increasing T were also made for different cooling fields (H/sub c/$_1$) The changes of M/sub R/ with H/sub c//sub 1/ and T are found to reduce to a universal relationship between the temperature-normalized quantities, m = M/sub R//M_0(T) and h = H/sub c//sub 1/ /H_0(T). Setting both the initial slope of m vs h and the saturation m at high h equal to unity, we determine that $M_0(T) = M_0(0) \exp(-T/T_0)$, with $M_0(0)$ = 0.82μ/sub B//Tb atom and T_0 = 4.3 K, and that H_0(T) varies analogously, with $H_0(0)$ = 225 kOe and the same T_0. A similar temperature scaling of M/sub R/ vs H/sub c// sub 1/ , with similar exponential forms for M_0(T) and H_0(T), has been deduced earlier for Ag-Mn and other canonical spin glasses.

27800 **Spin-glass dynamics in Fe/sub 2-//sub x/Ti/sub 1+//sub x/O_5.** Lichti, R.L.; Kumar, S.; Boekema, C. (Texas Tech University, Lubbock, Texas 79409). *Journal of Applied Physics;* **63**: No. 8, 4351-4353(15 Apr 1988).

Zero-field muon-spin-relaxation (μSR) and X-band ESR have been used to study the spin-freezing dynamics in single crystals of the Ising spin glass Fe/sub 2-//sub x/ Ti/sub 1+//sub x/ O_5 . Parameters obtained for the power-law and Vogel—Fulcher descriptions of the critical slowing are consistent with other methods for x = 0 and indicate significantly slower freezing in Ti-rich samples. Interpretation of cluster effects, observed in x = 0.25-μSR data, as a Griffiths-like phase yields an estimate of 61 +- 1 K for the Neel temperature in site-ordered Fe_2TiO_5 .

27801 **Radiation damage and annealing in graphite implanted with H^+Z and Mo^+.** Roth, J.; Zuhr, R.A.; Withrow, S.P.; Eatherly, W.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **63**: No. 8, 2603-2608(15 Apr 1988). Contract AC05-84OR21400.

Radiation damage due to H^+_2 and Mo^+ implantation into hot-worked pyrolytic graphite and into single-crystal graphite flakes has been studied using 1-MeV $^4He^+$ ion channeling. The implant energies used, 35 keV for H^+_2 and 120 keV for Mo^+, yielded ranges of about 1600 and 600 A, respectively. For H_2 implantation, a partially crystalline surface layer remains after a fluence of 2 x 10^{16} H/cm^2; this layer is completely disordered at 2 x 10^{17} H/cm^2. At higher hydrogen fluences a surface layer exfoliates. For Mo implantation the disorder introduced at a fluence of 5 x 10^{14} Mo/cm^2 is sufficient to prevent channeling throughout the range. For both implant species, complete recrystallization of samples disordered up to the surface occurs for annealing only at temperatures above 2800 K. If a surface layer remains crystalline after implantation, recrystallization proceeds both from the bulk and from the surface, and crystallinity is restored at 2300 K. While hydrogen is known to be released at temperatures between 1100 and 1500 K, Mo remains within its original range distribution up to the temperature of complete recrystallization. At a temperature of 2300 K an ordering of the implanted Mo atoms with respect to the c axis is observed, indicating short-range migration within the range distribution. At 2800 K no more Mo could be found in the analyzed surface layer.

27802 Dynamic high pressure process for fabricating superconducting and permanent magnetic materials. Nellis, W.J.; Geballe, T.H.; Maple, M.B. (to Dept. of Energy, Washington, DC). US Patent 4,717,627. 5 Jan 1988. Filed date 4 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for preparation of a class of fine grain solid materials having desirable superconducting or magnetic properties is described comprising the steps of: providing a first planar layer of a first predetermined solid material, with the first layer having a first end and a second end spaced apart from one another and facing one another along the plane defining the first planar layer; providing a second planar layer comprising a second predetermined material in powder form, with the second layer having a first end and a second end spaced apart from one another and facing one another along the plane defining the second planar layer; providing a third planar layer of a third predetermined solid material, positioned so that the second layer lies between and is transversely contiguous with the first layer and the third layer, with the third layer having a first end and a second end spaced apart from one another and facing one another along the plane defining the third planar layer; providing an open container for the first, second and third planar layers, providing a shock wave with velocity of propagation that is supersonic with respect to the speed of sound in each of the first, second and third predetermined materials; causing the shock wave to propagate substantially transversely through the first planar layer, the second planar layer and the third planar layer in that order so that the second layer of powder is compressed and heated to a temperature substantially as large as or greater than the highest melt temperature of the materials comprising the second layer, with an associated shock wave pressure of at least 50 kilobars.

27803 Environmentally induced chemical changes in pavement asphalts and asphalt-aggregate mixtures. Claine Petersen, J. (Western Research Institute (USA)). pp 397-412 of Environmental degradation of engineering materials. Louthan, M.R.; McNitt, R.P.; Sisson, R.D. University Park, PA; Pennsylvania State University (1987). (CONF-870466—).

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

Two major environmental factors having detrimental effects on asphalt pavements are the actions of atmospheric oxygen and water. Asphalt, being a complex hydrocarbon mixture, reacts with atmospheric oxygen, causing chemical changes that harden and embrittle the asphalt during pavement service. The chemical changes occurring in the asphalt during oxidative aging are described. In many pavement mixtures, water can weaken or destroy the adhesive bond between the asphalt and the aggregate, resulting in a loss of pavement structural strength. The chemistry of the asphalt-aggregate bond and the action of water on this bond are also described.

27804 Measurement of the luminescence quantum efficiency of GSGG:Cr/sup 3+/ by laser calorimetry. Ramponi, A.J.; Caird, J.A.; Milanovich, F.P.; Robel, R.W. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550 (US)). pp 170 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper THGG 54.

The conversion of photon energy into thermal energy by nonradiative relaxation processes causes the temperature of laser materials to rise. In the present study, laser calorimetry was used to determine the room-temperature fluorescence quantum efficiency of GSGG:Cr/sup 3+/. A related technique employing an electronically compensated calorimeter was recently used to measure the fluorescence quantum efficiency for Cr/sup 3+/ in lithium lime silicate glass and in ruby. Other methods for measuring quantum efficiencies of ions in solids include photometric methods utilizing an integrating sphere and photacoustic measurements. The advantage of laser calorimetry over the latter two methods is its relative ease of calibration. Experimental methods and optimization of two techniques are discussed. The ability to determine absolute temperature changes in a sample allows for measurement of thermal loading in laser materials under monochromatic or flashlamp pumping. Excessive heating limits the capacity of solid-state laser materials to operate at high-average-power levels. Measurements of thermal loading in several other laser materials are also discussed.

40 CHEMISTRY

27805 (PB—88-858642/XAB) Liquid membranes. January 1970-February 1988 (Citations from the Engineering Index data base). Report for January 1970-February 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 42p. NTIS PC N01/MF N01.

Supersedes PB—86-865995.

This bibliography contains citations concerning the development and utilization of liquid membranes and liquid-membrane methods. Topics include ion transport properties of membranes, modeling studies, and investigations of potential distribution and diffusion phenomena. Applications include metals separation and recovery, wastewater treatment, and solute extraction. (This updated bibliography contains 82 citations, 18 of which are new entries to the previous edition.)

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 27698, 28005, 28078

27806 (AD-A—188452/7/XAB) Chromatographic and related reactors. Final report, 1 October 1983-30 September 1987. Langer, S.H. (Wisconsin Univ., Madison (USA). Dept. of Chemical Engineering). 7 Jan 1988. 6p. NTIS, PC A02/MF A01.

Several variations of gas- and liquid-column chromatographic reactors were investigated. In connection with this, new information on the kinetics and course of the base-catalyzed esterification reaction of tetrachloroterephthaloyl chloride and its derivatives was obtained with ^{13}C Nuclear Magnetic Resonance. The operation and conversion in a reverse-phase liquid chromatographic reactor could be analyzed on a quantitative basis when consideration was given to the associative interaction between the stationary phase and elements of the mobile phase. Furthermore, the composition and models for the stationary phase could be examined on the basis of the kinetics of reaction of the tetrachloroterephthaloyl derivatives. A related procedure for determining the phase ratio was developed. Mass-transfer limitations for chromatographic reactions were also analyzed. Incorporation of a void column between two packed liquid-chromatographic columns made it possible to decouple esterification-rate constants for both the mobile and stationary phase. The stopped-flow liquid chromatographic reactor was found to be viable for conversions and operation but not amenable to quantitive analysis because of ionic-strength effects with the systems. Operation of a version of the stopped-flow-gas chromatographic reactor was successful and applications to studies of catalytic reactions were demonstrated. The rate of the CO methanation reaction even could be measured at room temperature on supported nickel, ruthenium, and cobalt catalysts.

27807 (INIS-BR—1045) Kinetic of oxidation to air of a Fe-Al-Mn alloy system at 600-800/sup 0/C temperature range. Lins, V.F.C. (Minas Gerais Univ., Belo Horizonte (Brazil). Escola de Engenharia). 1987. 106p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702309/JAW.

The Fe-Mn-Al-Si alloy, with 0.6% carbon content, was studied under oxidation to air conditions, at 600-800/sup 0/C temperature range. The results of the continuous thermogravimetric tests indicate that, at 600/sup 0/C, the oxidation can be described by logarithmic kinetics. For temperatures from 650 to 800/sup 0/C, a parabolic kinetic behavior was obtained for the Fe-Mn-Al alloy. Using x-ray diffraction, austenite was initially observed and after oxidation, besides austenite, the presence of ferrite was detected, which is the only evidence of a possible decomposition of the matrix phase. The (Mn,Fe)/sub 2/O/sub 3/ oxide was found as one of the components of the oxidized layer, using x-ray diffraction. Re-

gions rich in aluminium, manganese and silicon, in the oxide film, were observed by scanning electron microscopy. A good resistance to oxidation was obtained at 600-700/sup 0/C temperature range.

27808 **(INIS-BR—1055) Determination of fluoride ions in water by condutometric titration with lanthanum nitrates.** Alves, J.C. (Sao Paulo Univ. (Brazil). Inst. de Quimica). 1986. 96p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702319/JAW.

An alternative method for determining fluoride ions in drinking water by condutometric titration using La(NO/sub 3/)/sub 3/ as titrant is presented. The method is based on previous separation of fluoride from sample by distillation at 135/sup 0/C. The pH of the distillated is adjusted between 5,5 - 6,0; ethanol is adicioned in 50% titrating the resultant solution with La(NO/sub 3/)/sub 3/. In these conditions, fluoride ions are determined with accuracy respectively, 5% and 4%. Natural samples of drinking water were analysed by this method and by the ion selective method, with agreement among the results.

27809 **(JINR—18-87-561) Software of two-dimensional radiochromatograph on-line with the DVK-1 microcomputer.** Cheremukhina, G.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702429/JAW.

The software of two-dimensional radiochromatograph based on positive sensitive detectors for an express-analysis of thin layer chromatographs labelled with radioisotopes /sup 125/I, /sup 14/C, /sup 35/S, /sup 32/P, /sup 3/H is described. The radiochromatograph operates by control of DVK-1 microcomputer with peripheral devices-floppy disk, alpha-numerical display and D-100 printer. Software general functions are acquisition, statistical processing and graphic representation of physical data. Radiochromatograph control is relaized as a dialog. 7 refs.; 3 figs.

27810 **(PB—88-858485/XAB) Ion-selective electrodes. January 1970-February 1988 (citations from the Engineering Index data base). Report for January 1970-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 95p. NTIS PC N01/MF N01.

Supersedes PB—86-873957.

This bibliography contains citations concerning the development and applications of ion-selective electrodes. Topics include theoretical aspects, performance evaluations of specific devices, sensitivity and response characteristics, and calibration studies. Applications include analyses of fresh and marine waters, reaction monitoring, biomedical analyses, industrial processes, and online monitoring techniques. Some attention is given to soils analyses and detection limits of various devices. (This updated bibliography contains 228 citations, 42 of which are new entries to the previous edition.)

27811 **(PINSTECH/NMD—119) Determination of hydrogen in zirconium and its alloys by melt extraction under carrier gas flow using thermal conductivity cell as detector.** Akhtar, J.; Ahmed, M.; Mohammad, B.; Jan, S.; Waqar, F. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Materials Div.). Jun 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702481/JAW.

In the production of zirconium metal and its alloys the presence of hydrogen impurity affects mechanical and corrosion resistance properties of the product. Therefore, determination of hydrogen contents of the product is necessary. Conditions for its analysis by melt extraction under carrier gas stream using thermal conductivity cell as detector were studied and optimised. The method is capable of measuring hydrogen impurity in parts per million range.

27812 **Diode laser spectroscopy of the νZ band of CD_3.** Frye, J.M.; Sears, T.J.; Leitner, D. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **88**: No. 9, 5300-5306(1 May 1988). Contract AC02-76CH00016.

CD_3 radicals were generated by excimer laser photolysis (248 nm) of CD_3 I, and the transient populations detected by diode laser absorption using a gated integrator signal averager. The ν_2 = 1left-arrow0, 2left-arrow1, and 3left-arrow2 bands of the CD_3 radical were observed, and band center frequencies were determined to be 457.8133(11), 507.9311(19), and 542.4510(29) cm^{-1}, respectively. Observed transitions were fitted, by least squares analysis, to yield rotational and centrifugal distortion constants and spin—rotation parameters, and results are compared to theory. Measurements were also carried out of the time dependence of the vibration—rotation level populations as a function of vibrational excitation and spin component.

27813 **Structure and bond energy of $ArCl_2$.** Evard, D.D.; Cline, J.I.; Janda, K.C. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Journal of Chemical Physics;* **88**: No. 9, 5433-5438(1 May 1988).

The geometry and bond energy of $ArCl_2$ are obtained by the technique of parity selected excitation spectroscopy. This is a pump—probe technique in which the probe laser is set to detect specific rotational levels of the B state of Cl_2 while the pump laser is tuned through an $ArCl_2$ B—X band. Since the excitation spectrum obtained depends on the parity of the detected Cl_2 rotational level, the $ArCl_2$ complex must have a symmetrical, T-shaped geometry on average over the time scale of the experiment, ~100 ps. Simulation of the observed spectra, which show partially resolved rotational structure, yields an argon to chlorine center of mass distance of 3.7 A for both the X and B electronic states of the complex. By measuring the threshold for dissociation to the v = 6, j = 8 level of the Cl_2 B state, the Ar—Cl_2 bond energy was determined to be 178 cm^{-1} in the B state and 188 cm^{-1} in the X state. These results are quite different from those on the isovalent complex ArClF which is a linear molecule with an Ar—Cl bond length of 3.33 A, and a bond energy of 230 cm^{-1}.

27814 **Ultratrace analysis of transuranic actinides by laser-induced fluorescence.** Miller, S.M. (to Dept. of Energy, Washington, DC). US Patent 4,724,217. 9 Feb 1988. Filed date 21 Mar 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for detecting ultratrace quantities of weakly or non-fluorescing transuranic actinides in water, is described comprising the steps of: (a) coprecipitating an actinide in a water sample with host precursor materials to form a precipitate, the precipitate comprising a preselected host material which includes at least one fluorescent component species having a near resonant energy level with the actinide and whose fluorescence is quenched or sensitized by the actinide; (b) illuminating the precipitate with laser light of a preselected wavelength, the wavelength being selected in the case of sensitizing by the actinide to excite the actinide to a level above and sufficiently close to the near resonant energy level of the at least one fluorescent component species to cause substantial nonradiative decay from the actinide to the near resonant energy level; (c) measuring a difference in intensity between the fluorescence of the at least one fluorescent component species which has been quenched or sensitized by the actinide from the sample and the fluorescence of the at least one fluorescent component species in at least one standard, the at least one standard having been prepared with a known concentration of the actinide; and (d) determining the concentration of the actinide in the sample by relating the difference in the fluorescence intensity to quantitative differences between the concentration of the actinide in the sample and the concentrations of the actinide in the at least one standard.

27815 **Application of waveguide Raman spectroscopy to high-index dielectric films.** Tallant, D.R.; Higgins, K.L.; Stewart, A.F. (Sandia National Laboratories, Albuquerque, New Mexico 87185 (D.R.T., K.L.H.); and Air Force Weapons Laboratory, Kirtland AFB, New Mexico 87117 (A.F.S.)). *Applied Spectroscopy;* **42**: No. 2, 326-330(Feb 1988). Contract AC04-76DP00789.

Waveguide Raman spectroscopy has been applied to the analysis of single-layer, refractory-oxide, thin-film coatings on fused silica. With the use of the film as a waveguide, the interaction of the laser probe beam with the film is maximized, and interference from the silica substrate is minimized. An amorphous film of Ta_2O_5 was found to be an excellent waveguide, yielding an intense Raman

spectrum. Even though polycrystalline films of Y_2O_3, ZrO_2, HfO_2, and ThO_2 were found to be poor waveguides, they still yielded Raman spectra containing useful structural information. Such Raman spectra showed that the ThO_2 film was intitially in an unusual structural form, which spontaneously transformed into cubic ThO_2. Even for films yielding relatively weak Raman bands, substrate Raman scattering was not a serious interference. Representative spectra are presented, along with a brief discussion of the requirements for coupling optical beams into films with large refractive indices.

27816 **Site-selection phosphorimetry via singlet-state excitation.** Vo-Dinh, T.;Lamotte, M. (Advanced Monitoring Development Group, Health & Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6101). *Applied Spectroscopy;* 42: No. 1, 65-68(Jan 1988). Contract AC05-84OR21400.

This paper describes the technique of excitation energy site-selection (SS) phosphorimetry for chemical analysis of polycyclic aromatic compounds in Shpolskii matrices at 4.2 K. The principle of the SS phosphorescence technique, which uses excitation via the singlet state and produces narrow-band phosphorescence, is discussed. The analysis of a three-component mixture is used to illustrate the spectral selectivity of the SS phosphorimetric technique.

27817 **Problems in the analysis of solid waste extracts derived from leaching tests.** Maskarinec, M.P.; Francis, C.W. (Oak Ridge National Lab., TN (USA)). pp 26-27 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—). Contract AC05-84OR21400.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

This paper examines limitations in commonly used methods of analysis of solid wastes extracts. Procedures discussed include the EPA toxicity characteristic leaching procedure; atomic absorption spectroscopy; inductively coupled plasma spectroscopy; purge and trap techniques; liquid/liquid extraction; and gas chromatography/mass spectroscopy. Significant problems are posed by matrix effects and the presence of acetate/acetic acid in simulated leachates.

27818 **The significance of inductively coupled plasmas relative to other laboratory plasmas in analytical spectrometry.** Montaser, A.; Golightly, D.W. (Dept. of Chemistry, George Washington Univ., Washington, DC (US)). pp 1-13 of Inductively coupled plasmas in analytical atomic spectrometry. Montaser, A.; Golightly, D.W. New York, NY; Van Nostrand Reinhold Co. Inc. (1987).

The current popularity of inductively coupled plasmas (ICPs) in analytical spectrometry stems from the remarkable selectivities and sensitivities that make them so applicable to "the chemical analysis of things as they are." By any reasonable measure, the three major ICP-based methods, that is, atomic emission spectrometry (ICP-AES), atomic fluorescence spectrometry (ICP-AFS), and mass spectrometry (ICP-MS), have approached a set of ideal requirements for elemental analysis. Classical techniques, such as, flame, arc, and spark spectrometries, although currently in use in various laboratories, have been less successful in achieving the capabilities listed in this table. Flamelike electrical discharges, such as the direct-current plasma (DCP) and the microwave induced plasma (MIP), in contrast to the ICP, do not possess annular channels for injecting the sample through the core of the discharge, thereby reducing efficiencies of vaporization, atomization, ionization, and excitation due to diminished plasma-sample interaction. This unique property, that is, the axial channel of the ICP, has been mainly responsible for certain desirable characteristics, such as relative freedom from matrix interferences, detection limits in the picogram-to-nanogram range, a linear dynamic range of 4 to 5 orders of magnitude, and precision of measurement of 1 to 3% relative standard deviation. Moreover, the common ICP-based techniques are fundamentally capable of isotopic analysis, although this potential has been demonstrated for ICP-AES and ICP-MS only. This overview provides a brief summary of some of the potentials and drawbacks of ICPs and other discharges for elemental analysis.

27819 **High-resolution plasma spectrometry.** Edelson, M.C. (Ames Lab., U.S. Dept. of Energy, Iowa State Univ., Ames, IA (US)). pp 239-263 of Inductively coupled plasmas in analytical atomic spectrometry. Montaser, A.; Golightly, D.W. New York, NY; Van Nostrand Reinhold Co. Inc. (1987). Contract W-7405-ENG-82.

In this chapter, the authors consider the topic of high-resolution plasma spectrometry (HRPS). Several different experimental approaches to HRPS are reviewed, and the benefits derived from increased spectral resolution are discussed. Results from the scientific literature are presented, but no attempt is made to provide an encyclopedic review. The discussion is limited to plasma emission spectrometry and, in particular, to inductively coupled plasma-atomic emission spectrometry (ICP-AES).

27820 **Mixed-gas, molecular-gas, and helium inductively coupled plasmas operated at atmospheric and reduced pressures.** Ohls, K.D.; Golightly, D.W.; Montaser, A. (Hoesch Stahl AG Dortmund, Chemical Labs., Dortmund (DE)). pp 563-596 of Inductively coupled plasmas in analytical atomic spectrometry. Montaser, A.; Golightly, D.W. New York, NY; Van Nostrand Reinhold Co. Inc. (1987).

In this chapter, both the atmospheric-pressure and reduced-pressure ICPs commonly used for spectrochemical analysis are considered. The advantages and limitations of the various ICPs are discussed in Section 15.2. The instrumentation required for plasma formation is considered in Section 15.3. A brief review on the generation of various ICPs and their operating conditions is given in Section 15.4. Fundamental and analytical properties of mixed-gas, molecular-gas, and He ICPs are treated in Section 15.5. Finally, the use of these plasmas in analytical applications is summarized. Because a review article by M.I. Boulos has been published in the 1985 volume of Pure and Applied Chemistry, no discussion of computer modeling of the ICP is included here. Seven general review articles and books are cited in the Bibliography to assist the reader in obtaining an expanded discussion of various nonargon ICPs used for spectro-chemical analysis and to remind the new ICP investigator of the availability of a wealth of information on very-high-power ICPs used in material engineering. To simplify the discussion, the terms "mixed-gas ICP" and "molecular-gas ICP" are used to classify the plasmas. In a mixed-gas plasma, Ar is mixed with molecular gas or He in one or more of the gas flows of the ICP torch. In contrast, to form a molecular-gas plasma, pure molecular gases are individually introduced into the gas inlets of the torch.

27821 **Trace element measurements using white synchrotron radiation.** Hanson, A.L.; Jones, K.W.; Gordon, B.M.; Pounds, J.G.; Kwiatek, W.M.; Long, G.J.; Rivers, M.L.; Sutton, S.R. (Brookhaven National Lab., Upton, NY (USA)). pp 400-404 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC02-76CH00016.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Synchrotron radiation, when used for X-ray fluorescence (XRF) has several advantages over conventional X-ray sources. Their group at Brookhaven National Laboratory is developing the equipment and expertise to make XRF measurements with synchrotron radiation. The apparatus is briefly described, along with the alignment techniques. Some minimum detectable limits for trace elements in thin biological standards measured with white light irradiations are presented.

27822 **Applications of synchrotron x-ray fluorescence to extraterrestrial materials.** Sutton, S.R.; Rivers, M.L.; Smith, J.V. (Univ. of Chicago, IL (USA)). pp 405-409 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Synchrotron X-ray fluorescence (SXRF) is a valuable technique for trace element analysis of extraterrestrial materials permitting minimum detection limits less than 1 ppm for 20 μm spots. SXRF measurements have been performed on iron meteorites and micrometeorites using white synchrotron radiation and an energy dispersive X-ray detector at the National Synchrotron Light Source (X-26C), Brookhaven National Laboratory (NY). Partitioning of Cu between troilite (FeS) and metal in the nine iron meteorites studied suggests subsolidus re-equilibration in these objects. A technique has been developed for determining self-absorption corrections for filtered, continuum excitation of small specimens, such as stratospheric particles and refractory inclusions in meteorites.

27823 **Comparison of XRF and PIXE on aerosol samples.** Tomic, S.; Valkovic, V.; Budnar, M.; Starc, V.; Smit, Z. (Rudjer Boskovic Institute, Zagreb (Yugoslavia)). pp 609-612 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Aerosol particles were collected in the Plomin power plant and the Kolektor factory of copper lamellas using a cascade impactor. The results of the elemental analysis of particles performed using two analytical methods, XRF and PIXE, show very good agreement. Concentrations of Ca, Cr, Fe, and Cu in aerosols, calculated using both methods, are given and discrepancies discussed.

27824 **Determination of trace elements in body fluids by XRF spectroscopy.** Nadj, M.; Injuk, J.; Lakatos, J.; Valkovic, V. (Rudjer Boskovic Institute, Zagreb (Yugoslavia)). pp 613-616 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

X-ray emission spectroscopy is used for trace element analysis of body fluids. Analytical procedures that include sample preparation and XRF setup are described for the analysis of blood serum and amniotic fluid samples for different gravidity stages. The comparison between the distribution of these elements in amniotic fluid and serum is presented and discussed.

27825 **PIXE analysis of trace elements in tissues of rats treated with anticonvulsants.** Hurd, R.W.; Van Rinsvelt, H.A.; Kinyua, A.M.; O'Neill, M.P.; Wilder, B.J.; Houdayer, A.; Hinrichsen, P.F. (V.A. Hospital, Gainesville, FL (USA)). pp 617-620 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Several lines of evidence implicate metals in epilepsy. Anticonvulsant drugs are noted to alter levels of metals in humans and animals. PIXE analysis was used to investigate effects of three anticonvulsant drugs on tissue and brain cortex trace elements. The content of zinc and copper was increased in liver and spleen of rats treated with anticonvulsants while selenium was decreased in cortex.

27826 **Crystallography using the diffraction of proton induced x-rays.** Rickards, J. (Instituto Politecnico Nacional, Postal (Mexico)). pp 621-624 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Diffraction (Kossel) patterns are obtained by bombarding single crystals with a 700 keV proton beam and collecting the emitted characteristic x-rays on photographic film. The diffraction curves appear superimposed on the isotropic (in the case of K-lines) distribution typically obtained when non-single-crystal targets are bombarded. They are identified using stereographic projection. In contrast to previous uses of this technique, variable line intensities were observed. They were compared with calculation intensities using a geometrical model based on: proton energy loss, x-ray production cross section, and attenuation before and after being diffracted, as well as competition between reflection and deficiency. A good agreement was obtained. The calculations were carried out up to 5 MeV proton energy and also for a simulated microbeam.

27827 **PCRACE: a program for the analysis of PIXE spectra for use on a IBM PC/XT.** Greenberg, S.H.; Williams, E.T.; Perley, B.; Eldred, R.; Shadoan, D.J. (Brooklyn College, NY (USA)). pp 625-626 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The authors describe both the original RACE program developed at UC Davis by Eldred and Harrison for PIXE spectrum analysis on a PDP 15/40 with 48K of memory, and the subsequent modification and reconfiguration at Brooklyn College to adapt the code for use on an IBM PC/XT. The program is written in Fortran 77 and it is ideally suited for aerosol samples and on thin substrates.

27828 **Beam developments for the Harwell microprobe system.** Read, P.M.; Cookson, J.A.; Alton, G.D. (Harwell Lab., Oxon (England)). pp 627-634 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A consequence of the rapid development of micron and submicron size electronic devices is the diminished applicability of high energy ion microprobes with their present resolution limitations to the study of such components. Although submicron beams have been reported the available beam current is barely sufficiently for PIXE and is not adequate for RBS. This lack of lateral resolution is due to low beam brightness at the microprobe object and aberrations in the focusing elements. As part of a program to address these problems the Harwell microprobe lens has been relocated on a new 5 MV Laddertron accelerator. The increased brightness and improved stability of this facility has so far led to a reduction in beam size from 3 x 3 μm^2 to about 2 x 2 μm^2. The feasibility of using a liquid metal ion source has been examined with a view to achieving more substantial increases in brightness. While such sources have brightness approximately 10^5 times greater than conventional gaseous sources the highly divergent nature of the beam presents problems for the beam transport system. The use of a liquid metal source on the accelerator has been successfully demonstrated but it indicates the need for a special low aberration injection lens if brightness is to be maintained.

27829 **Microbeam RBS and PIXE applied to microelectronics.** Morris, W.G.; Fesseha, S.; Bakhru, H. (General Electric Corp. Research and Development Center, Schenectady, NY (USA)). pp 635-637 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A microprobe which supplies a beam of 2 MeV He^+ ions is used to analyze surface layers on microelectronic circuits. The beam is focused to a diameter of about 2 μm on a circuit, and the backscattered ions and characteristic x-rays are detected. Secondary electrons emitted from the sample as the beam is scanned in a raster are also sued to form an image to aid in positioning the beam on particular features. The beam current can be controlled by setting the opening at the object slits, and is typically 0.1-0.5 nA for a 2 μm beam. The backscattering spectrum and x-ray spectrum are col-

lected simultaneously with a typical collection time of 5 min. Verification of metallization thickness, incomplete metal removal during etching, and external contamination have been observed.

27830 **Biomedical application of the nuclear microprobe.** Lindh, U. (Uppsala Univ. (Sweden)). pp 638-642 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The Studsvik Nuclear Microprobe (SMP) has mainly been devoted to applications in the biomedical field. Its ultimate resolution is reached at 2.9 x 2.9 μm^2 with a proton current of 100 pA. With this performance the SMP has been used in a wide range of disciplines covering environmental hygiene, toxicology, various aspects of internal medicine and trace element physiology. Examples of recent applications in these fields are described.

27831 **Trace element and surface analysis at the University of Montreal.** Houdayer, A.; Hinrichsen, P.F.; Gujrathi, S.C.; Martin, J.P.; Monaro, S.; Lessard, L.; Oxorn, K.; Janicki, C.; Brebner, J.; Belhadfa, A.; Yelon, A. (Universite de Montreal, Quebec (Canada)). pp 643-647 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The Tandem at the Laboratoire de Physique Nucleaire is now used for: Rutherford backscattering spectroscopy (RBS) and elastic recoil detection (ERD) with time of flight (TOF), channeling-ERD/RBS/PIXE, high energy implantation, and PIXE (proton induced x-ray emission) trace element analysis. A PIXE/RBS microbeam on the 4.5 MV Dynamitron will also be described.

27832 **Improvements of the Eindhoven proton microbeam.** Mutsaers, P.H.A.; Prins, M.; Van Der Heide, J.A.; Klein, S.S. (Eindhoven Univ. of Technology (Netherlands)). pp 648-651 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The EUT microbeam is produced from a cyclotron beam by a 1 x 1 mm object diaphragm and a quadruplet lens system of high demagnification. To limit the effect of chromatic aberrations the beam energy spread can be reduced by tuning the beam transport system to a dispersive mode and the aperture of the lens system can be reduced. With the transport system in the normal achromatic mode, using 3.5 MeV protons a spot of 60 x 40 μm with a beam current of 150 nA is obtained. In the dispersive mode a spot of 10 x 10 μm with a beam current of 2 nA can be achieved. The microprobe is used for scanning PIXE analysis and three dimensional NRA and RBS.

27833 **Small inexpensive scattering chamber constructed from commercially available components.** Guardala, N.A.; Williams, E.T.; Farrell, J.P. (Brooklyn College, NY (USA)). pp 652-654 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A 6-way Dependex(tm) multicross with four 6-in. and two 4-in. ports serves as the basis for a home-built scattering chamber. A target assembly ladder, mounted vertically, can accommodate up to five targets. These can be aligned at angles ranging from 0 to 75° with respect to the incident beam. Both particles and photons can be measured with the appropriate solid state detectors. Special attention has been focused on the problems of accurate and reproducible charge collection. The chamber is suitable for PIXE, PIGE, RBS, atomic and nuclear cross-section determinations.

27834 **Application of an external beam PIXE method for determining the distribution of trace metals in degraded and nondegraded crude oils.** Fischbeck, H.J.; Engel, M.H.; Ruffel, A.V.; Weaver, B.L. (Univ. of Oklahoma, Norman (USA)). pp 655-657 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

External beam proton induced x-ray emission (PIXE) analysis was used for the direct determination of the distributions and abundances of trace metals in crude oils. The accuracy and reproducibility was found to compare favorably with wavelength dispersive x-ray fluorescence spectrometry (WD-XRF) and neutron activation analysis (NAA). Trace metal analysis of degraded and nondegraded Colombian oils of similar origin revealed that, while the degraded oils were enriched in the trace metals Ni and V, the ratio Ni/V was relatively unaffected by degradation processes. The Ni/V ratio of the asphaltene fractions were very similar to the Ni/V ratios for the respective whole oils. The aromatic and NSO fractions, however, had higher Ni/V values than their respective whole oils. The distributions of other metals such as Fe and Zn in the oils and their respective fractions were found to be less reliable for correlation purposes.

27835 **Trace elements in human nasal cavity bones.** Wheeler, R.M.; Chaturvedi, R.P.; Onello, J.S.; Valkovic, V.; Krmpotic, J. (State Univ. of New York, Cortland (USA)). pp 658-661 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

In recent years, the use of synchrotron radiation for high-sensitivity trace multielement analysis has been well established. We have used a white x-ray beam from the Brookhaven National Synchrotron Light Source to analyze trace elements in nasal cavity bones from both males and females of various ages. Ca, Fe, Cu, Zn, Pb, and Sr were routinely identified. A 30 x 60 μm photon beam was used to scan the sample to see variations in elemental concentrations. Results of our preliminary analysis as well as future plans to analyze more bone and other biomedical samples will be discussed.

27836 **Measurement of absolute at concentration in Al/sub x/Ga/sub 1-x/As.** Yan, D.; Farrell, J.P.; Lesser, P.M.S.; Pollak, F.H.; Kuech, T.F.; Wolford, D.J. (Brooklyn College of CUNY, NY (USA)). pp 662-666 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A technique has been developed to measure the absolute Al concentration x in Al/sub x/Ga/sub 1-x/As. The technique involves simultaneous measurements of the $^{27}Al(p, \gamma)\ ^{28}Si$ resonant nuclear reaction and Rutherford backscattering (RBS), and comparisons with an AlAs reference sample. A detailed description of the experimental procedure is given. Samples analyzed in this study were prepared by LPE and MOVPE growth on GaAs substrates, with epitaxial layer thicknesses in the range 1-3 μm and Al concentrations in the range $0.10 < x < 0.85$. Measurements of x with an absolute error < 0.02 were obtained. Factors limiting the precision obtainable with this technique are discussed.

27837 **Accelerator mass spectrometry at Toronto.** Kieser, W.E.; Beukens, R.P.; Kilius, L.R.; Litherland, A.E.; Nadeau, M.J.; Rucklidge, J.C. (Univ. of Toronto (Canada)). pp 667-671 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Progress in accelerator mass spectrometry at the IsoTrace Laboratory is outlined. Results from calculations on quantum mechanical effects in the sputter source which influence isotope fractionation are presented with examples from radiocarbon analysis. Advantages accruing from the installation of an electric analyzer in the low energy beam transport system are discussed with examples from chlorine and carbon analysis.

27838 **Accelerator-based mass spectrometry of methane.** Fowler, M.M.; Lysaght, P.; Wilhelmy, J.B. (Los Alamos National Lab., NM (USA)). pp 672-675 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract W-7405-ENG-36.

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Accelerator-based Mass Spectrometric (AMS) methods have not been generally applied to the analysis of molecular species because of difficulties with ion sources and the fact that tandem accelerators are not generally applicable. A method has been developed to measure the abundance of fully deuterated methanes, $^{13}CD_4$ and $^{12}CD_4$, in normal methane by using AMS. A low-energy electron bombardment ion source has been coupled to a single-ended electrostatic accelerator to produce positively charged molecular ions. The ions are accelerated, mass selected, and then dissociated into fragments that are detected by nuclear particle detection methods. In this way information about the composition of the original molecule, as well as the mass, is obtained. Measurements on natural neon, $^{13}CH_4$, $^{12}CD_4$, $^{13}CD_4$, and $^{13}CD_4$ have been made, and new approaches to the stabilization of accelerator voltage and isotopic abundance calibration are presented. Possible applications for analysis of other molecules not easily measured with conventional AMS are considered.

27839 **Accelerator mass spectrometry of ^{36}Cl, ^{129}I and ^{187}Os.** Kubik, P.W.; Elmore, D.; Fehn, U.; Phillips, F.M. (Univ. of Rochester, NY (USA)). pp 676-681 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

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The accelerator mass spectrometry program at Rochester is at present based on measurements of the long-lived radioisotopes ^{36}Cl and ^{129}I, and on the determination of osmium isotope ratios in sub-ppb level samples. This paper describes the present configuration of the instrument and some recent results.

27840 **Fluorine depth analysis using Rutherford backscattering.** Khubeis, I.G.; Ziegler, J.F. (Univ. of Jordan, Amman). pp 682-687 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Rutherford backscattering (RBS) of helium ions seems to be a feasible method for the depth analysis of fluorine. Targets of thickness between 30 and 3B24/250 A of calcium fluoride and magnesium fluoride were bombarded with 2.3 MeV alpha particles. The number of atoms of fluorine per cm^2 as a function of the thickness of the targets and the target substrates were measured. The effect of substrate material on the measured number of atoms/cm^2 of fluorine is negligible.

27841 **Non-Rutherford proton scattering in RBS spectra.** Knox, J.M.; Harmon, J.F. (Idaho State Univ., Pocatello (USA)). pp 688-690 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

It has long been known that it is possible to take advantage of non-Rutherford scattering to enhance the sensitivity of backscattering spectrometry for light elements. The authors have utilized recently published proton cross section data to demonstrate the utility of this phenomenon for enhanced sensitivity for carbon and other light elements. RBS spectra illustrating the enhancement for C and F and Si in a number of materials are presented.

27842 **Microanalysis of fluorine using the $^{19}F(p, \alpha_0)^{16}O$ reaction.** Khubeis, I.; Ziegler, J.F. (Univ. of Jordan, Amman). pp 691-694 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

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The $^{19}F(p, \alpha_0)^{16}O$ nuclear reaction seems to be an excellent method for high resolution fluorine depth profiling. Target tilting, a pulse pileup rejection circuit and a high resolution solid state detector were employed. Magnesium fluoride, calcium fluoride and fluorohydrocarbon targets of different thickness were used. The detection of the outcoming alpha particles was done with and without Kapton foils. A depth profile resolution of 10 nm was obtained and 3 nm appears to be feasible.

27843 **Intense lithium ion beam diagnostic using the inverse nuclear reaction $D(^7Li, n)^8Be$.** Leeper, R.J.; Kim, K.H.; Hebron, D.E.; Wing, N.D.; Norbeck, E. (Sandia National Labs., Albuquerque, NM (USA)). pp 695-697 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract AC04-76DP00789.

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The decision to employ high voltage lithium ion beams on the 100 TW PBFA-II accelerator has prompted the investigation of using the inverse nuclear reaction $D(^7Li, n)^8Be$ as an intense beam diagnostic. The diagnostic scheme operates by utilizing the high energy neutrons that are emitted from the $D(^7Li, n)^8Be$ reaction when a ^7Li beam is incident upon a target containing deuterons. These high energy neutrons can in turn induce the $^{63}Cu(n, 2n)^{62}Cu(\beta^+)$ reaction. This amount of 9.74 min ^{62}Cu activity formed can then be measured and related to the total number of ^7Li in the beam. The results of calibration runs using ^7Li beams accelerated to energies from 1 to 32 MeV are summarized.

27844 **Analysis of oxygen on and in beryllium using 2 MeV helium ions.** Musket, R.G. (Lawrence Livermore National Lab., CA (USA)). pp 698-700 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract W-7405-ENG-48.

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Analysis of oxygen on beryllium can be routinely performed using helium-ion backscattering (RBS). However, determination of the bulk oxygen concentration by this technique is limited to about 350 atomic parts per million (appm). We have performed simultaneous RBS and particle-induced x-ray emission (PIXE) measurements to improve the detection limit for bulk oxygen. The RBS measurements allowed determination of the surface oxygen before and after in situ sputter cleaning by argon ions in an ultra-high-vacuum system. PIXE measurements of specimens with surfaces maintained

clean by sputtering permitted assessment of the concentration of oxygen in the bulk. For our geometry and detector sensitivity, 90% of the oxygen x-ray signal originated in the first 2.1 μm of the beryllium and a detection limit of 10 appm was found.

27845 Nuclear analysis of zirconium nitride thin films. Simpson, J.C.B.; Earwaker, L.G.; Khan, M.N. (Univ. of Birmingham (England)). pp 701-704 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

As part of a development program for the production of zirconium nitride coatings by radio-frequency sputtering of red-hot zirconium rod targets in a nitrogen atmosphere, a series of thickness and stoichiometry measurements has been performed. A variety of nuclear analysis techniques have been used in the characterization of the coatings. Concentration depth profiles were obtained using both alpha particle and deuteron backscattering. Nitrogen depth profiles were obtained independently using the $^{14}N(d, \alpha)^{12}C$ and $^{14}N(d, p)^{15}N$ nuclear reactions. The results of this investigation confirmed correspondence to stoichiometric ZrN and revealed the compositional uniformity of the deposited layers.

27846 Nuclear physics for materials technology. Conlon, T.W. (Harwell Lab., Oxon (England)). pp 705-710 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

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Although particle accelerators have traditionally been used to further our knowledge of nuclear physics, the last decade or so has seen a rapid growth of their involvement in materials technology - both to modify materials and to provide analytical information at the atomic level that cannot be obtained in other ways. The deployment of ion beams in these areas has occurred in three phases: first the exploitation of keV ion beams (in ion implantation and SIMS) then MeV light ion beams (using RBS, NRA, PIXE analysis and TLA) and currently MeV heavy ion beams, together with the associated fast recoil atoms and nuclei that they produce in interactions with materials. This trend has been accompanied by the gradual assimilation of methods such as energy analysis, microbeam focusing, particle identification, time of flight and coincidence techniques, etc., which were first developed for experimental nuclear physics use. Current examples of developments in the MeV range relevant to phases 2 and 3 are given.

27847 Hydrogen isotope and light element profiling in solid tritium targets used for neutron production. Earwaker, L.G.; England, J.B.A.; Goldie, D.J. (Univ. of Birmingham (England)). pp 711-716 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Five targets consisting of titanium tritide layers on copper backings have been investigated using nuclear reaction analysis. As these targets are commonly used to produce monoenergetic neutrons via the $T(p, n)^3He$ and $T(d, n)^4He$ reactions, it is important to know of the presence of other elements which may produce neutrons at different energies. The thicknesses of the titanium tritide layers were measured by observing the $T(p, n)^3He$ threshold yield curve and also the energy spread of the neutrons using a ^3He-filled gridded ion chamber. Elastic recoil analysis with a particle identifying system was used to measure the hydrogen, deuterium, tritium and ^3He content, and elastic scattering was used to study the carbon and oxygen. Surprisingly high concentrations of both hydrogen and oxygen were found on all targets, including the three which had never been used. Also surprising was the ^3He content which was approximately the same for targets of all ages and conditions of use. As expected, the carbon content increased strongly with use, originating no doubt, from vacuum pump oil. Up to 3% deuterium atoms were observed in unused targets with much higher contents being recorded in used targets.

27848 Ion beam analysis with a 6 MV Van de Graaff. Leavitt, J.A. (Univ. of Arizona, Tucson (USA)). pp 717-721 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

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Rutherford backscattering and channeling techniques using ^4He analysis beams with energies less than 2.5 MeV have proven to be powerful methods for determination of stoichiometry, structure, thickness and impurity concentrations in thin films. The authors discuss examples illustrating the advantages of routine use of analysis ion beams (from a single-ended 6 MV Van de Graaff) with energies greater than 2.5 MeV. We compare 170° ^4He backscattering spectra obtained at higher energies (3.8 and 4.7 MeV) with similar spectra obtained at 1.9 MeV to show that use of the higher energies leads to simplified data analysis, greater probing depth and more accurate determination of film stoichiometry. We briefly report progress in attempts to (1) use backscattering of ^{12}C analysis beams to obtain improved mass and depth resolution, (2) use ^4He analysis beams to depth profile P in Si using (α, p) nuclear reactions at incident ^4He energies of 3.655 and 4.343 MeV and (3) use $^{15}N^{2+}$ analysis beams with energies ≧ 6.3 MeV to depth profile ^1H in films using the $(^{15}N, \alpha\gamma)$ nuclear reaction at 6.385 MeV.

27849 Analytical possibilities of medium energy tritium beams ($3 < E < 12$ MeV) and application to the analysis of oxygen in InP. Bordes, N.; Blondiaux, G.; Maggiore, C.J.; Valladon, M.; Debrun, J.L.; Coquille, R.; Gauneau, M. (CNRS-CERI, Orleans (France)). pp 722-724 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

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The authors have studied the possibilities of medium energy tritium beams for light element (B, O, Mg, Si S) determinations. We measured activation curves and sensitivities. The incorporation and repartition of oxygen during crystallogenesis of single crystal InP was studied. After irradiation and chemical etching, ^{18}F from the $^{16}O(t, n)^{18}F$ reaction was extracted from aqueous solution by diphenyldichlorosilane and the 511 keV annihilation radiation measured with a Ge(Li) detector. Two single crystal ingots showed oxygen segregation from seed end to tail end. The average oxygen content was 5-8 x 10^{15} at/cm^3. With 6 MeV tritium, the detection limit is 4 x 10^{15} at/cm^3.

27850 Study of the incorporation and repartition of boron and carbon in Czochralski grown GaAs using charged particles activation. Wei, L.C.; Blondiaux, G.; Giovagnoli, A.; Valladon, M.; Debrun, J.L. (CNRS-CERI, Orleans (France)). pp 999-1002 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

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Charged particles activation methods were developed to study the incorporation and the repartition of B and C at trace level in GaAs ingots grown by the Czochralski method with liquid B_2O_3 encapsulation. The $^{10}B(d, n)^{11}C(d,n)^{12}N$ reactions were used for the analysis of boron and of carbon. Radiochemical separations of ^{11}C and of ^{12}N after irradiation were necessary. For the separation of ^{11}C the samples were oxidized in a mixture of B_2O_3 and Pb_3O_4, and CO_2 was trapped in KOH. For the separation of ^{13}N, the samples were fused under argon in a graphite crucible, and N_2 trapped on titanium at 900°C. Detection limits were ~ 10^{14} at/cm^3 for carbon and 3 x 10^{14} at/cm^3 for boron. Important (factors ~ 50) concentration variations could be correlated to the growth condi-

tions, particularly the percentage of water in B_2O_3. A segregation of B and C in the ingots was also observed. B concentrates at the tail end, and C concentrates at the seed end.

27851 Simultaneous determination of P and N in human tissue by 14 MeV neutron activation analysis. Mao, Y.; Ehmann, W.D.; Markesbery, W.R. (Univ. of Kentucky, Lexington (USA)). pp 1003-1005 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A simple 14 MeV neutron activation procedure for the simultaneous determination of P and N in human tissue has been developed. Paired 12.7 x 12.7 cm NaI(Tl) detectors were used for γ-ray detection. A coincidence counting system was used to monitor annihilation radiation from ^{13}N, and a dual sum-invert amplifier and MCA were used to count the ^{28}Al γ-ray from P. NBS SRM 1577 (Bovine Liver) was chosen as the primary standard for both determinations. For replicate runs, the observed standard deviation of the specific activities for standard samples is typically +/- 3% relative.

27852 Use of a high repetition rate neutron generator for in vivo body composition measurements via neutron inelastic scattering. Kehayias, J.J.; Ellis, K.J.; Cohn, S.H.; Weinlein, J.H. (Brookhaven National Lab., Upton, NY (USA)). pp 1006-1009 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract AC02-76CH00016.

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A small D-T neutron generator with a high pulse rate is used for the in vivo measurement of body carbon, oxygen and hydrogen. The core of the neutron generator is a 13 cm-long Zetatron tube pulsed at a rate of 10 kHz delivering 10^3-10^4 neutrons per pulse. A target-current feedback system regulates the source of the accelerator to assure constant neutron output. Carbon is measured by detecting the 4.44 MeV γ-rays from inelastic scattering. The short half-life of the 4.44 MeV state of carbon requires detection of the γ-rays during the 10 μs neutron pulse. Generators with low pulsing rate were found inappropriate for carbon measurements because of their low duty-cycle (high neutron output during the pulse). In vivo measurements were performed with normal volunteers using a scanning bed facility for a dose less than 25 mrem. This technique offers medical as well as general bulk analysis applications.

27853 Applications of fast neutrons activation analysis (FNAA) at Birmingham. Randle, K. (Univ. of Birmingham (England)). pp 1010-1013 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Both prompt and standard FNAA techniques are used at Birmingham University. The former uses 14 MeV neutrons from a conventional neutron generator whilst the latter uses both these and neutrons from the 3-MeV deuteron bombardment of beryllium, using the Dynamitron accelerator. Standard FNAA involving the separate irradiation and counting of samples has been used widely and examples in various areas of research are given including determination of excitation functions. Prompt FNAA has been mainly concerned with the determination of the major elements in coal and various oil- or water-bearing matrices. The use of 14 MeV neutrons enables elements to be determined both by capture gamma-ray analysis and gamma-rays from inelastic scattering. The latter allows a much more sensitive determination of oxygen in particular, but also of carbon.

27854 Determination of the composition of HgCdTe oxide films by neutron activation analysis. Gnade, B.; Simmons, A.; Little, D.; Strong, R. (Texas Instruments, Inc., Dallas (USA)). pp 1014-1016 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

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The composition of HgCdTe oxides grown by anodic oxidation in a standard KOH/ethylene glycol solution has been determined by neutron activation analysis (NAA). This technique is not hindered by the difficulties normally associated with methods using ion beams or electron beams. Neutron activation analysis has the advantage of being quantitative, and also NAA is not affected by the chemical composition of the matrix. The analysis of the KOH/ethylene glycol oxide film by neutron activation yields Hg:Cd:Te ratios of 0.534:0.19:1, in close agreement with Rutherford backscattering spectroscopy analysis (R.L. Strong et al. J. Vac. Sci. Technol. A4 (4) (1986) 1992).

27855 Automated pneumatic transfer system for oxygen determinations by neutron activation analysis. Filpus-Luyckx, P.E.; Ogugbuaja, V.O. (Shell Development Co., Houston, TX (USA)). pp 1017-1020 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

This report describes a newly installed automated sample transfer and data acquisition and analysis system for oxygen determinations by neutron activation analysis. Oxygen is an important element for oil products research. The laboratory at the Westhollow Research Center of the Shell Development Company performs about 1600 oxygen determinations per year.

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27856 (AD-A—188571/4/XAB) Evaluation and prediction of Henry's law constants and aqueous solubilities for solvents and hydrocarbon fuel components. Volume 1. Technical discussion. Final report, February 1985-September 1986. Howe, G.B.; Mullins, M.E.; Rogers, T.N. (Research Triangle Inst., Research Triangle Park, NC (USA)). Sep 1987. 97p. NTIS, PC A05/MF A01.

Laboratory measurements of Henry's law constants are reported for 51 chemicals, spanning a wide range of chemical structures and volatilities. A static headspace method (Equilibrium Partitioning in Closed Systems, referred to as EPICS) was used to measure Henry's Law Constant, with the standard-batch air-stripping method used as a check. An average precision of 5% was obtained for the EPICS runs, and the Henry's law constants agreed reasonably well(within 10%) with the batch air-stripping results and other reported experimental values. Measurements were conducted over a temperature range of 10-30 C, and the data were correlated with a temperature regression equation coupled with a temperature-dependent error term based on 95% confidence limits. The aqueous solubilities of the study compounds were also determined via the shake-flask method at temperatures of 10, 20, and 30°C.pacts

27857 (INIS-BR—1019) Compounds of addition between yttrium and rare-earths (III) nitrates and the N,N,N'N'-tetramethyladipamide (TMAA). Lima, W.N. de. (Sao Paulo Univ. (Brazil). Inst. de Quimica). 1974. 145p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702284/JAW.

The synthesis of addition compounds between hydrated rare-earths and yttrium nitrates with the diamine N,N,N',N'-tetramethyladipamide (TMAA) in ethanol, is described. The compounds were

characterized by elemental analisys, infrared, Raman, visible and near infrared spectra, molar conductance and molecular weight measurements, conductometric titrations and X-ray powder patterns.

27858 **Turing patterns in an open reactor.** Vastano, J.A.; Pearson, J.E.; Horsthemke, W.; Swinney, H.L. (Department of Physics, University of Texas, Austin, Texas 78712). *Journal of Chemical Physics;* **88**: No. 10, 6175-6181(15 May 1988).

Steady spatial chemical patterns have been found in model reaction—diffusion systems but have not yet been observed in any laboratory experiments. The reasons for this are discussed and the need for open reactors is stressed. A model open reactor is investigated in order to guide the experimental search for steady patterns. Specifically, Turing bifurcations in this reactor are studied for a simple autocatalytic chemistry (the Gray—Scott model) in order to determine the effects of varying diffusion coefficients, chemical time scales, and residence time. A description of all the steady-state bifurcations from an initially homogeneous state is obtained. The Liapunov—Schmidt reduction is used to determine the stability of the bifurcating solutions and a steady-state continuation technique is used to follow stable and unstable branches of bifurcating solutions.

27859 **Reaction of iron clusters with ammonia. I. Compositions of the ammoniated products and their implications for cluster structure.** Parks, E.K.; Nieman, G.C.; Pobo, L.G.; Riley, S.J. (Chemistry Division, Argonne National Laboratory, Argonne Illinois 60439). *Journal of Chemical Physics;* **88**: No. 10, 6260-6272(15 May 1988). Contract W-31-109-ENG-38.

Studies are described of the chemisorption of ammonia on isolated neutral iron clusters Fe/sub n/ for $2 \leqq n \leqq 165$. Clusters are generated by laser vaporization in a continuous-flow-tube reactor, and reaction products are detected by laser-ionization time-of-flight mass spectrometry. Ammonia is found to chemisorb nondissociatively on cluster surfaces on the 1 ms time scale of these experiments. Measurements of ammonia uptake provide information on adsorption kinetics and on the number and nature of the binding sites. The ammonia binding energy is found to decrease with increasing cluster coverage. For chemically saturated clusters, the ratio of adsorbed NH_3 molecules to surface iron atoms is found to decrease with increasing cluster size, going from $>1/3$ for small clusters to $<1/3$ for $n>100$. Ammonia chemisorption is accompanied by a large decrease in cluster ionization potentials, as much as 2 eV for saturated clusters. At sufficiently high exposure the beginning of the formation of a second, physisorbed layer of molecules is seen. Detailed measurements of product composition under different exposure conditions give evidence for numerous changes in cluster structure throughout the growth sequence from small to large clusters. Often these structural changes involve particularly stable reaction products. Evidence for the existence of metastable structures is presented. Several possibilities for cluster structure are suggested.

27860 **Theoretical characterization of the minimum energy path for the reaction $H+O_2 \rightarrow HO^*_2 \rightarrow HO+O$.** Walch, S.P.; Rohlfing, C.M.; Melius, C.F.; Bauschlicher C.W. Jr. (ELORET Institute, Sunnyvale, California 94087). *Journal of Chemical Physics;* **88**: No. 10, 6273-6281(15 May 1988).

The potential energy surface for the reaction $H+O_2 \rightarrow HO/sup\ */_2 \rightarrow HO+O$ has been characterized in the vicinity of the minimum energy path using CASSCF/contracted CI calculations with a basis set which is triple zeta valence quality plus three sets of polarization functions. CASSCF/CI calculations were carried out along the CCI minimum energy path. The latter calculation shows essentially no barrier for addition of an H atom to O_2, in agreement with predictions made in earlier studies. The potential surface for recombination of OH and O is complicated by a crossing, at r/sub OO/ $\approx 5.5 a_0$, between the surface for electrostatic (OH dipole—O quadrupole) interaction and that for the formation of an O—O chemical bond. This surface crossing results in a small ($\approx$0.5 kcal/mol) barrier.

27861 **Hydrogen atom abstraction by $O(^3P)$ from diborane and ethane.** Borchardt, D.B.; Choi, J.; Suzuki, K.; Bauer, S.H. (Department of Chemistry, Baker Laboratory, Cornell University, Ithaca, New York 14853). *Journal of Chemical Physics;* **88**: No. 10, 6282-6289(15 May 1988).

We measured, via LIF, time-dependent concentrations of OH resulting from the reaction of $O(^3P)$ with B_2H_6 and C_2H_6. The oxygen atoms were generated by titrating microwave discharged N_2 /He with NO to the chemiluminescent end point. The operating pressures in the flow reactor ranged from 5 to 15 Torr; the mixtures consisted of He/$O(^3P)$/fuel in the approximate ratios 100/1/0.1 to 100/1/1. Flow conditions were such that in the low pressure experiments the controlled residence time prior to detection were 0.8—17 ms; under the higher pressure conditions, the time interval covered was 2—35 ms. We estimated that the temperature of the reaction region was $\approx$350 K, based on rotational emission temperatures measured for BO*, generated under closely similar conditions. First a complete mechanism was derived for ethane for a specified set of experimental parameters. For ethane, a single set of experimental conditions was selected for ratioing the recorded intensity to the computed OH density; this was cross checked with other runs for ethane. Finally, a mechanism was developed for B_2H_6, which quantitatively checked our experimentally determined profiles both in shape and magnitude, for three sets of conditions, and within a factor of 2 for the high concentration runs (100% B_2H_6 feeding into the reactor at 14 Torr).

27862 **Diffusion-controlled reactions: Mathematical formulation, variational principles, and rigorous bounds.** Rubinstein, J.; Torquato, S. (Department of Mathematics, Stanford University, Stanford, California 94305-2125). *Journal of Chemical Physics;* **88**: No. 10, 6372-6380(15 May 1988).

This paper is concerned with the problem of predicting the effective rate constant k associated with diffusion-controlled reactions in media composed of static and reactive traps (sinks) which are generally distributed randomly throughout a region containing reactive particles. The effective equation for diffusion-controlled reactions is derived using the method of homogenization. This leads to a rigorous definition of k. General variational principles are then formulated to obtain rigorous upper and lower bounds on k. These variational principles are applied by evaluating them for three different types of admissible fields. The upper and lower bounds which result are computed for both random and periodic arrays of equisized spherical sinks.

27863 **Molecular dynamics calculation of free energy.** Lutsko, J.F.; Wolf, D.; Yip, S. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **88**: No. 10, 6525-6528(15 May 1988). Contract W-31-109-ENG-38.

The results of a systematic study of a recently proposed method by Frenkel and Ladd for calculating free energies via molecular dynamics are reported. Internal measures of the error, the effect of varying parameters, and comparison of the relative computational efficiency of the method compared to other methods is considered. In particular, agreement with the quasiharmonic method is shown for temperatures up to 75% of melting.

27864 **Laser-induced desorption: Thermal and nonthermal pathways.** Burgess D. Jr.; Cavanagh, R.R.; King, D.S. (Center for Chemical Physics, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Chemical Physics;* **88**: No. 10, 6556-6569(15 May 1988).

Distributions of internal states and kinetic energies are reported for the laser-induced desorption of NO from a platinum foil. Two desorption channels are observed, one with internal-state populations which are well fit by Boltzmann distribution functions that correspond to the peak surface temperature. The second desorption channel displays population distributions which are non-Boltzmann: kinetic energies exceed the peak surface temperature by a factor of $\approx$5; kinetic energies depend on J; the spin—orbit states are inverted; and the vibrational population exceeds that associated with the maximum surface temperature by a factor of 50. The wavelength dependence of the non-Boltzmann desorption signal suggests that a substrate mediated desorption process is operative.

27865 Ultraviolet photoelectron spectroscopy of copper clusters. Pettiette, C.L.; Yang, S.H.; Craycraft, M.J.; Conceicao, J.; Laaksonen, R.T.; Cheshnovsky, O.; Smalley, R.E. (Rice Quantum Institute and Department of Chemistry, Rice University, Houston, Texas 77251). *Journal of Chemical Physics;* **88**: No. 9, 5377-5382(1 May 1988).

Using a new magnetically focused time-of-flight photoelectron spectrometer, the ultraviolet photoelectron spectra (UPS) of mass-selected negative copper clusters have been measured at photon energy of 4.66 eV for all clusters in the range from 6 through 41 copper atoms. These UPS data provide the first detailed probe of the 4s valence band structure of such medium size negative copper clusters, and extend previous approximate measures of the electron affinity of the corresponding neutral species. The results are in accord with the predictions of the ellipsoidal shell model for monovalent metal clusters. In particular, clusters 8, 20, and 40 (which correspond to spherical shell closings in this simple model) are found to have unusually low electron affinities and large HOMO—LUMO gaps. Subshell closings at 14 and 34 also appear special in this new UPS data.

27866 Final state and velocity distribution of the reaction $D+H_2 \rightarrow HD+H$ as a function of scattering angle. Blais, N.C.; Truhlar, D.G. (Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **88**: No. 9, 5457-5464(1 May 1988).

We present quasiclassical trajectory calculations of velocity-angle contour maps and state distributions as a function of scattering angle for the reaction $D+H_2 \rightarrow HD+H$. These are calculated using the Liu—Siegbahn—Truhlar—Horowitz potential energy surface. The results show higher vibrational excitation and lower rotational excitation of the backscattered products as compared to the total product distribution. In addition to their fundamental interest, these calculations should be useful in interpreting experiments in which state-to-state differential cross sections are measured.

27867 Photoionization studies of (BH_3)/sub n/ (n = 1,2). Rus-hacekcic, B.; Mayhew, C.A.; Berkowitz, J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **88**: No. 9, 5580-5593(1 May 1988). Contract W-31-109-ENG-38.

The results of photoionization mass spectrometric studies on B_2H_6, and BH_3 (produced by pyrolysis of B_2H_6) are presented. The photoion yield curves of B_2H^+/sub n/ (n = 2—6) and BH^+/sub n/ (n = 2—3) from B_2H_6, as well as BH^+/sub n/ (n = 1—3) from BH_3 have been obtained. It is shown that the combination of appearance potential measurements for BH^+_2 (B_2H_6) and BH^+_2 (BH_3) yields a poor upper limit for -ΔH/sub dimerization, 0//sub //sub K/ (BH_3) of 52.7 kcal/mol, while the combination of BH^+_2 (B_2H_6) and BH^+_2 (BH_3) provides a better upper limit (46.6 +- 0.6 kcal/mol) for this quantity. However, the threshold for BH^+ (BH_3), combined with auxiliary data, provides the best current experimental value, (34.3-39.1) +- 2 kcal/mol. This experimental value is in good agreement with a recent ab initio calculation, and is arrived at by using the best current estimate of ΔH/sub f/(B_2H_6), rather than a radically different value proposed in that paper. The ionization potential of BH_3, ΔH/sub f/ (BH^+_2), and the atomization energy of BH_3 obtained experimentally are in excellent agreement with other ab initio calculations. The upper limits on heats of formation for the ionic species B_2H^+/sub n/ (n = 2—6) are obtained, and plausible structures are discussed for these species, based on the current energetics and various ab initio calculations.

27868 Molecular dynamics studies of complexing in binary molten salts with polarizable anions: MAX_4. Sabougni, M.; Rahman, A.; Halley, J.W.; Blander, M. (Chemical Technology Division/Materials Science and Technology Program, Argonne National Laboratory, Argonne, Illinois 60439-4837). *Journal of Chemical Physics;* **88**: No. 9, 5818-5823(1 May 1988). Contract W-31-109-ENG-38.

Anion polarizations have been introduced in a molecular dynamics simulation of a complexing ionic liquid MAX_4 similar to tetrachloroaluminates. The influence of the polarizability on the structure of the melt has been deduced from the radial distribution functions, the numbers of nearest and next nearest neighbor pairs, the distribution of coordination numbers, and the angular distribution of various triplets. Surprisingly, A_2X_6 molecular species, similar to those postulated to exist in acid haloaluminate melts, were detected in our simulated "neutral" melt. The stability of other species (e.g., $A_2X^-_7$ and A_2X^-/sub 10/) that were present in the simulated MAX_4 melt with nonpolarizable X anions decreased when polarization was introduced.

27869 Prediction of angular distributions for the $F+H_2$ and $F+D_2$ reactions. Hayes, E.F.; Walker, R.B. (Department of Chemistry, Rice University, Houston, Texas 77251). *Journal of Chemical Physics;* **88**: No. 9, 5978-5979(1 May 1988).

The bending corrected rotating linear model is used to predict angular distributions for the reactions $F+H_2(v = 0) \rightarrow H+HF(v' = 2,3)$ and and $F+D_2(v = 0) \rightarrow D+DF(v' = 3,4)$. The calculations were performed using the surface (No. 5A) that was reported recently by Steckler, Truhlar, and Garrett. The angular distributions obtained using this new surface differ in several important respects from distributions predicted in earlier quantal scattering studies using the Muckerman-5 surface. More importantly, these new predictions are in much better agreement with the high resolution molecular beam studies of these same reactions. The combination of these predictions with the results of the molecular beam studies provides additional evidence for the role of dynamical resonances in the two title reactions.

27870 Unimolecular dissociation of vinylacetylene: a molecular reaction. Kiefer, J.H.; Mitchell, K.I.; Kern, R.D.; Yong, J.N. (Univ. of Illinois, Chicago (USA)). *Journal of Physical Chemistry;* **92**: No. 3, 677-685(11 Feb 1988). Contract FG02-85ER13384;FG02-85ER13340.

The thermal decomposition of vinylacetylene (C_4H_4) has been studied in the shock tube with two time-resolved diagnostics, laser-schlieren (2% and 4% C_4H_4-Kr, 1650-2500 K, 110-427 Torr) and time-of-flight mass spectrometry (2% C_4H_4-Ne 1500-2000 K, 150-300 Torr). The time-of-flight mass spectra show dominant products C_2H_2 and C_4H_3 with a very consistent 5:1 ratio of C_2H_2 to C_4H_3. The laser-schlieren semilog density gradient profiles the effective heat of reaction between 30 and 50 kcal/mol. Rate constants calculated from the zero-time gradients assuming $\Delta H^\circ_{298} = 40$ kcal/mol are fit with a routine RRKM model which indicates a barrier $E_0 = 79.5$ +/- 3 kcal/mol. Detailed balance rate constants for $2C_2H_2 \rightarrow C_4H_4$ are in good agreement with the extensive previous data on the second-order acetylene reaction, confirming that vinylacetylene is a direct and dominant product of C_2H_2 dimerization for moderate temperatures. Above 1500 K, the C_4H_4 dissociation shows significant falloff even for high pressures, and the now dominant C_4H_3 in C_2H_2 pyrolysis may then be formed in part through $2C_2H_2 \rightarrow C_4H_3 + H_2$. It is proposed that vinylacetylene dissociates as a substituted ethylene, either by 1,1-elimination of molecular hydrogen, leaving vinylidene acetylene which rapidly isomerizes to C_4H_2, or by 2,2-elimination of C_2H_3, followed by rapid isomerization of the vinylidene to a second C_2H_2.

27871 Rate constants for F^- transfer from SF_6^- to fluorinated gases and SO_2. Temperature dependence and implications for electrical discharges in SF_6. Sieck, L.W.; Van Brunt, R.J. (National Bureau of Standards, Gaithersburg, MD (USA)). *Journal of Physical Chemistry;* **92**: No. 3, 708-713(11 Feb 1988).

The reactivity of SF_6^- toward SO_2, SOF_2, SO_2F_2, SOF_4, SF_4, and SiF_4 has been investigated by using the technique of pulsed electron beam high-pressure mass spectrometry. These studies were initiated in order to probe the complex anionic chemistry occurring during electrical discharge in SF_6. Although no reaction of any type was observed with SOF_2 and SO_2F_2, efficient F^- transfer of the type $SF_6^- + A \rightarrow AF^- + SF_5$ was found in all of the other systems including the $SO_2F^- + SOF_4$ pair, which was studied separately. With the exception of the $SF_6^- + SiF_4$ reaction, all of the pairs exhibited a negative temperature coefficient in that the rate constants for F^- transfer decreased substantially with increasing temperature. The reaction $SF_6^- + SiF_4 \rightarrow SiF_5^- + SF_5$ was found to proceed with a rate constant of (5.6 +/- 0.8) x 10^{-10} cm^3/(molecule.s) throughout the temperature range studied (298-510 K), which corresponds to a collision efficiency of unity. The other re-

actions were found to approach unit collision efficiency only at reduced temperatures (<300 K). The reactions studied were used to provide additional information concerning the gas-phase F^- affinity scale. Some comments are included concerning the stability of the SF_6^- x SF_6 dimer ion, and the implications of all of the present data with respect to mobility measurements in SF_6 are also discussed.

27872 Small-angle neutron scattering studies on Brij-58 micelles. Schefer, J.; McDaniel, R.; Schoenborn, B.P. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Physical Chemistry;* **92**: No. 3, 729-733(11 Feb 1988).

Brij-58 is a nonionic surfactant used to solubilize membrane proteins such as Na/K ATPase. Small-angle neutron scattering measurements were performed on Brij-58 micelles to determine their radius, aggregation number, molecular weight, and shape. The radius of gyration of the micelle at the indefinite contrast is 32 A, and its volume is 291,000 A^3. The aggregation number is 71 molecules per micelle, based on a molecular weight determination by forward scattering. The Stuhrmann plot is linear, indicating a centrosymmetric distribution of the scattering density. A two-shell spherical model was derived, consisting of a central hydrocarbon core and an outer shell of the head groups, intermixed with water.

27873 Methane activation by the lanthanide oxides. Campbell, K.D.; Zhang, H.; Lunsford, J.H. (Texas A & M Univ., College Station (USA)). *Journal of Physical Chemistry;* **92**: No. 3, 750-753(11 Feb 1988).

The catalytic production of gas-phase methyl radicals from methane over the lanthanide oxides was measured by using a matrix isolation electron spin resonance (MIESR) technique. The results show that metal centers with multiple stable oxidation states are not a requirement for activity. The oxide with the greatest activity per gram was hydrothermally treated La_2O_3, which was ca. 5 times more active than the next highest oxide. Hydrothermally treated La_2O_3 and Sm_2O_3 have the largest activities per square meter. Results obtained in a conventional flow reactor for selected oxides indicate that the CH_4 conversions per square meter are in the order $Nd_2O_3 > La_2O_3 > Sm_2O_3 > Dy_2O_3 > CeO_2$. Oxidative coupling of CH_4 results in the C_2H_6 and C_2H_4 (C_2 compounds), and the combined C_2 yields follow the same order with $Dy_2O_3 >> CeO_2$. The MIESR and flow reactor results are in qualitative agreement, with the exception of Nd_2O_3.

27874 Thermochemistry of thermal plasma chemical reactions. Part I. General rules for the prediction of products. Chang, Y.; Pfender, E. (Univ. of Minnesota, Minneapolis (USA)). *Plasma Chemistry and Plasma Processing;* **7**: No. 3, 275-297(Sep 1987). Contract FG02-85ER13433.

Equilibrium calculations based on the standard technique of minimization of the Gibbs free energy, with consideration of both gas and condensed phases, are shown to be inadequate for predicting the yield or even the proper composition of the products from thermal plasma reaction systems. This is due to the dominating influence of nucleation kinetics, a nonequilibrium effect. In this paper a modification of the equilibrium approach is proposed, whereby the supersaturation of a phase which may condense is calculated, and species with low supersaturation pressures which are unlikely to precipitate are subsequently removed from consideration. A comparison is made between the former equilibrium predictions and these quasi-equilibrium predictions. When compared with experimental data taken from the extant literature and from the authors' own research, the quasi-equilibrium modification is seen to provide excellent agreement with respect to product composition and yield. Examples are discussed including the thermal plasma production of hydrogen cyanide, ammonia, acetylene, silicon carbide, silicon nitride, and titanium carbide.

27875 Thermochemistry of thermal plasma chemical reactions. Part II. A survey of synthesis routes for silicon nitride production. Chang, Y.; Young, R.M.; Pfender, E. (Univ. of Minnesota, Minneapolis, MN (USA)). *Plasma Chemistry and Plasma Processing;* **7**: No. 3, 299-316(Sep 1987). Contract FG02-85ER13433.

Feasibility routes for thermal plasma production of silicon nitride powders are explored. First, a collation of the various proposed systems from the extant literature is examined. Reactant systems investigated include free silicon, silicon monoxide, silicon dioxide, silicon tetrachloride, silane, and other organosilicon precursors, along with various nitriding and reducing species. The reaction yields of these systems are brought to a common denominator by thermodynamic analysis and a first-step introduction of nucleation kinetics, including comparisons against published experiments and the authors' own research. In particular, it is observed that the formation of liquid-phase free silicon in the neighborhood of 2500 K is quite detrimental to silicon nitride yield, and furthermore, a high supersaturation of silicon should always be avoided.

27876 Hydrogen interactions with oxides in metals: An ion-beam study. Myers, S.M. (Sandia National Labs., Albuquerque (USA)). pp 159-170 of Environmental degradation of engineering materials. Louthan, M.R.; McNitt, R.P.; Sisson, R.D. University Park, PA; Pennsylvania State University (1987). (CONF-870466—). Contract AC04-76DP00789.

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

Experiments utilizing ion implantation and nuclear-reaction analysis have quantitatively characterized three hydrogen-binding mechanisms associated with oxide precipitates in Cu, Pd and Al. These basic mechanisms have the potential of influencing hydrogen behavior in numerous alloy systems. In Cu containing Cu/sub 2/O particles, and also in Pd containing PdO, reduction of the oxide by hydrogen to form water and/or hydroxide is the dominant process, even near room temperature. It is demonstrated that these strongly exothermic reactions can be conveniently exploited to measure both hydrogen permeability and ambient fugacity, and it is further suggested that such unstable oxides in bulk alloys could serve to retard detrimental hydrogen penetration. In Al containing Al/sub 2/O/ sub 3/ precipitates, two oxide-associated trapping mechanisms not involving a phase change were observed; the weaker is believed due to the formation of H/sub 2/ molecules at the metal oxide interface, whereas the stronger is tentatively attributed to chemical bonding at oxide defects.

27877 Solubility products and thermodynamic functions for praseodymium and ytterbium fluoride water systems. Abbas, R.; James, J.; Menon, M.P. (Savannah State College, GA (USA)). *Georgia Journal of Science;* **45**: No. 2, 75(1987). Contract FG09-84SR14014.

In continuation of our studies on rare earth-fluoride water system, we have measured the solubilities, solubility products and thermodynamic functions for PrF_3 (s)-H_2O(1) and YbF_3(s)-H_2O(1) systems by the conductometric method. The solubility and solubility products of PrF_3 are 4.8 x 10^{-5} and 1,1 x 10^{-16} and those of YbF_3, 5.4 x 10^{-5} M and 1.75 x 10^{-16}, respectively. The values for ΔH^0, ΔG^0 and ΔS^0 for the dissolution process of these fluorides as computed from the experimental data are 65.9 kJ mol^{-1}, 91.1 kJ mol^{-1} and - 84.5 J mol^{-1} K^{-1} for PrF_3 and 79.6 kJ mol^{-1}, 89.9 kJ mol^{-1} and - 34.5 J mol^{-1} K^{-3} for NdF_3, respectively. The significance and other aspects of this work will be discussed at the meeting.

27878 Isotope materials availability and services for target production at the Oak Ridge National Laboratory. Ratledge, J.E.; Dahl, T.L.; Ottinger, C.L.; Aaron, W.S.; Adair, H.L. (Oak Ridge National Lab., TN (USA)). pp 937-943 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Materials available through the Isotope Distribution Program include separated stable isotopes, byproduct radioisotopes, and research quantities of source and special nuclear materials. Isotope products are routinely available in the forms listed in the product description section of the Isotopes Products and Services Catalog distribution by the Oak Ridge National Laboratory (ORNL). Different forms can be provided in some cases, usually at additional cost. Routinely available services include cyclotron target irradiation, fabrication of special physical forms, source encapsulation, ion

implantation, and special purifications. Materials and services that are not offered as part of the routine distribution program may be made available from commercial sources in the United States. Specific forms of isotopic research materials include thin films and foils for use as accelerator targets, metal or other compounds in the form of bars or wires, and metal foils. Methods of fabrication include evaporation, sputtering, rolling, electrolytic deposition, pressing, sintering, and casting. High-purity metal forms of plutonium, americium, and curium are prepared by vacuum reduction/distillation. Both fissionable and nonfissionable neutron dosimeters are prepared for determining the neutron energy spectra, flux, and fluence at various locations within a reactor. Details on what materials are available and how the materials and related services can be obtained from ORNL are described.

27879 **Development of a polarized deuterium target by spin exchange with optically pumped K.** Young, L.; Holt, R.J.; Green, M.C.; Kowalczyk, R.S. (Argonne National Lab., IL (USA)). pp 963-966 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract W-31-109-ENG-38.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The development of a polarized internal target at an electron storage ring is of great interest for studies in nuclear physics. The deuterium nuclei acquire polarization via the hyperfine interaction after electron spin exchange with optically pumped potassium vapor. A high power laser which covers the entire Doppler width and hyperfine splitting of the ^{2}S/sub 1/2/-^{2}P/sub 1/2/ transition in potassium has been developed. Spin relaxation rates for potassium on various wall coatings have been measured. A dri-film surface has been shown to preserve polarization (> 100 bounces), be long-lived at elevated temperatures, and to be efficient at preventing deuterium recombination.

4005 Photochemistry

27880 **Photochemistry and spectroscopy of colloidal As_2S_3.** Mills, G.; Zongguan, L.; Meisel, D. (Argonne National Lab., IL (USA)). *Journal of Physical Chemistry;* **92**: No. 3, 822-828(11 Feb 1988). Contract W-31-109-ENG-38.

As_2S_3 colloids have been synthesized and characterized under various conditions. Particle sizes in the range of 150 to 50 A in diameter, depending on concentration of electrolytes, were observed in these preparations. The smaller particles show pronounced quantum size effects in spite of the conclusion that in all preparations the particles are of amorphous structure. Their absorption spectra were analyzed according to current theories for absorption spectra of noncrystalline materials. Thermal, photochemical, and radiation-induced dissolution reactions of the colloid have been studied with a particular emphasis on the reactions of oxygen species. An unusual reaction of O_2/sup .-/ radicals with the colloid has been observed. This reaction leads to a chain reaction and is, at least partially, responsible for the strong effect of oxygen in inducing the dissolution. It is proposed that this reaction results from a relatively high density of intraband gap traps in the collodial material.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 27534, 27535, 27536, 27880, 28067, 28481, 28482, 28483, 28497

27881 **(INIS-BR—1020) Radiolysis of Ca/sup 14/CO/sub 3/.** Sanchez, M.G.A. (Universidade Estadual de Campinas (Brazil). Inst. de Quimica). 1986. 196p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702285/JAW.

The partition-ion exclusion chromatography is evaluated to analyse non-ionic organic compounds obtained from radiolysis of high specific activity Ca/sup 14/CO/sub 3/. The Ca/sup 14/CO/sub 3/ was irradiated by β/sup -/ decay of carbon-14 or by γ rays from a cobalt-60 source. The crystals were dissolved for qualitative and quantitative analysis of the radiolytic products. Formic and oxalic acids were produced in high yields. Glyoxylic, acetic and glycolic acids, formaldehyde and methanol were produced in low yields. Quantitative determination was carried out by liquid scintillation spectroscopy and the chemical yields (G-values) were calculated for the products. Mechanisms of product formation are proposed based on thermal annealing experiments.

27882 **Time-dependent aspects of electron degradation: Pt. 1. Subexcitation electrons in helium or neon admixed with nitrogen.** Dillon, M.A.; Inokuti, M.; Kimura, M. (Argonne National Lab., IL (USA); Argonne National Lab., IL (USA); Rice Univ., Houston, TX (USA)). *Radiation Physics and Chemistry, International Journal of Radiation Applications and Instrumentation Part C;* **32**: No. 1, 43-48(1988). Contract W-31-109-ENG-38.

We present an analysis of the kinetic competition between the moderation of subexcitation electrons in a background gas and the excitation of impurity molecules. The central element of our method is the energy distribution of subexcitation electrons as a function of energy and time. The distribution obeys a linear partial differential equation of the first order, which is in general analytically solvable. The analysis is applied to He and Ne gases admixed with N/sub 2/, as studied by Cooper, Denison, and Sauer in their pulse radiolysis experiments. The temporal behavior of N/sub 2/ fluorescence, calculated from our analysis, agrees with experiment. The present treatment is an example of a general theory, which represents an extension of the Spencer-Fano theory to time-dependent cases.

27883 **Twin linac pulse radiolysis system (II).** Kobayashi, H.; Tabata, Y.; Ueda, T.; Kobayashi, T. (Univ. of Tokyo (Japan)). pp 1073-1076 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A new absorption spectroscopy system in which two parallel linacs were used, was reported at the last conference. In the system, one linac of the two is used as an irradiation source and the other is used as Cherenkov light source. Both of these linacs can accelerate very short electron pulses with a width of 10 ps. Time profile of transient species produced by irradiation can be obtained with a time resolution of 20 ps using this system. We call this new absorption spectroscopy system the Twin Linac Pulse Radiolysis System. At the last conference, the proof of the principle was reported. Now the construction of the twin linac pulse radiolysis system has been carried out. Two linacs with energy of 18 and 28 MeV respectively have been constructed using one 35 MeV linac without attaching a new microwave source. Time needed for switching from the single 35 MeV linac to the twin linac system and its reset becomes very short.

27884 **Comparisons of x-ray and gamma-ray sources for industrial irradiation processes.** Cleland, M.R.; Pageau, G.M. (Iotech, Inc., Northglenn, CO (USA)). pp 967-972 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Theoretical depth-dose distribution in water from 5 and 10 MeV x-ray (bremsstrahlung) are compared with those from ^{137}Cs and ^{60}Co gamma rays. Broad, planar sources and absorbers are assumed to avoid product-specific effects. Dose uniformity, photon and electron power utilization and equivalent source strength are calculated for each type of radiation as a function of absorber thickness for two-sided treatment. Source requirements and cost analyzes are presented for 5 MeV x-ray and ^{60}Co gamma-ray processing facilities to establish criteria for competitive x-ray systems.

27885 **LINAC radiation application.** Hockenbury, R.W.; Becker, M.; Moore, J.A.; Block, R.C. (Rensselaer Polytechnic Institute, Troy, NY (USA)). pp 973-975 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The RPI linac, originally built for neutron time-of-flight research, has been modified to allow both low and high electron energy beam radiation studies to be carried out on semiconductors and polymers over the energy range from 5 to 70 meV. Dose rates exceeding 10^{11} rad/s (Si) are achieved. The L-band microstructure of the accelerator allows for micropulses of 38 ps with 2 x 10^{13} rad/s in the pulse for high dose rate effects studies. Both in-house and external user programs are being carried out in semiconductors radiation effects. High injection effects, recombination mechanisms, and space charge and internally generated fields are being studied at high electron dose rates. Preliminary experiments have been made using the electron beam for radiation curing of polymer material. The high electron and photon energies available allow for greater depth-dose radiation curing control than previously obtainable in thick sections of polymer compounds. Electron and photon dosimetry measurements are also performed to correlate radiation effects with electron and photon energy spectra.

27886 **Important aspects of linac beams for food irradiation.** McKeown, J.; Jones, R.T. (Chalk River Nuclear Labs., Ontario (Canada)). pp 976-981 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Linac based irradiators will require careful design before they can be routinely adopted for the radiation processing of food. The transverse emittance and energy spread from simple injectors provide a significant challenge to the design of a beam delivery system which must handle high power especially in photon mode. Any nonuniform current distribution at the plane of the product is further complicated by large dose variations near the air/product interface, even with simple geometries. The paper describes the use of methods developed at AECL to control and monitor linac behavior as well as electron interactions at the product surface. It also reports on activation cross-section measurements and particularly on neutron yields from composite targets, designed to monitor the energy of accelerators used in food applications.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 28078

27887 **(KFK—3920) Experiments for training in nuclear and radiochemistry.** Moebius, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Schule fuer Kerntechnik). Jan 1988. 256p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88753271/JAW.

An experimental training program for education in Nuclear and Radiochemistry is outlined. Didactical aspects are discussed, the installation of a suitable radiochemical laboratory is described and the precautions for radiation protection summarized. Experiments including theoretical introduction, survey of apparatus and materials involved and experimental procedures are given for the topics of radiation and their measurement, radiochemical methods and application of radioisotopes. Technical terms most often used during the course are explained and a comprehensive literature survey is finally compiled.

27888 **Production of short-lived radiopharmaceuticals for pet.** Schlyer, D.J. (Brookhaven National Lab., Upton, NY (USA)). pp 925-927 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Research projects currently being undertaken in the area of positron emission tomography (PET), require the use of very high specific activity radiopharmaceuticals. The cyclotron targetry necessary to produce near carrier free radiopharmaceuticals has posed some interesting and challenging problems in target design and construction. Radionuclides are produced at Brookhaven from gas, liquid and solid targets. Each of these phases of matter has its own special problems associated with it. Besides the normal design considerations such as heat transfer, density reduction and beam scattering, other factors such as radiation damage to metal surfaces, surface wetting angles, transport line materials and solder fluxes must also be taken in account in the design of the target. The most difficult target in which to maintain the isotopic purity has proven to be the ^{11}C from nitrogen gas target. The most difficult target in which to maintain the chemical form and reactivity over long periods of time is the ^{18}F from ^{18}O water target. These targets and the design consideration which went into them are discussed in detail.

27889 **Recent developments of cyclotron produced radionuclides for nuclear cardiology.** Kulkarni, P.V.; Jansen, D.E.; Corbett, J.R. (Univ. of Texas Health Science Center, Dallas (USA)). pp 928-931 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

For over a decade myocardial perfusion imaging with thallium-201, a cyclotron product, has been routinely used in clinical medicine. Recent advances have allowed the efficient production of very high purity (> 99.8%) iodine-123. New metabolically active ^{123}I labeled radiopharmaceuticals, including alkyl and phenyl fatty acids, and norepinephrine analogs, have been developed and are undergoing clinical trials. Fab' fragments of monoclonal antibodies to cardiac myosin have been labeled with indium-111 (^{111}In) and are undergoing clinical evaluation for imaging myocardial infarcts. Monoclonal antibodies to platelets, fibrin, and the thrombolytic agent, tissue plasminogen activator (TPA), have recently been labeled with ^{111}In. Together these developments in radiotracers and instrumentation should have a significant impact on the future of cardiovascular nuclear medicine. This manuscript will discuss developments in single photon emitting radiotracers for myocardial imaging.

27890 **Gas targets for the production of ^{15}O, ^{11}C and ^{18}F for pet studies.** Hichwa, R.D.; Hugel, E.A.; Moskwa, J.J.; Raylman, R.R. (Univ. of Michigan Medical School, Ann Arbor (USA)). pp 932-936 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Production of ^{15}O, ^{11}C and ^{18}F is achieved with particle irradiation of gaseous targets. Design features for generalized targets include characterization of window materials and cooling, target size and shape, beam size and profile, and chamber cooling and operating pressure. A cylindrical design is employed that utilizes a C-ring for sealing the target window to the target body. Ultrapure materials are required for fabrication of ^{11}C and ^{18}F targets. Use of welded joints are to be limited on all targets and eliminated on ^{18}F systems. Tomographic techniques will be used to determine the cross-sectional temperature profile of target gases during bombardment. Mass species are measured with a sector focused mass spectrometer while the target undergoes particle irradiation for produc-

tion of clinical agents. This diagnostic information is useful for tailoring the bombardment conditions to achieve optimal precursor production and the highest specific activity that may be obtained from the target.

27891 **MIT-Bates cryogenic tritium target system.** Retzlaff, G.A. (Saskatchewan Accelerator Lab., Saskatoon (Canada)). pp 950-953 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A cryogenic tritium gas target system was constructed and used for a program of electron scattering studies at the MIT-Bates Accelerator Laboratory. The tritium was supplied and safely stored as solid UH_3. For the experiments, it was transferred to a thin walled cylindrical cell, where it was exposed to 20 μA electron beams with energies up to 800 MeV. The target contained 130 kCi of tritium at 225 psia and 45 K. Redundant safety enclosures surrounded both target and gas transfer systems. A microprocessor based control and monitoring system presented target parameters to the operators, flagging any nonstandard ones. This target system operated safely and effectively for 1500 h, enabling completion of a comprehensive elastic and inelastic scattering study of the tritium nucleus.

27892 **Modification and integration of JSW cyclotron gas targets at the National Institutes of Health Cyclotron Facility.** Finn, R.; Plascjak, P.; Sheh, Y.; Yamashita, Y.; Yoshida, H.; Adams, R.; Simpson, N.; Larson, S. (National Institutes of Health, Bethesda, MD (USA)). pp 954-956 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The Cyclotron staff at the National Institutes of Health is involved in a comprehensive radionuclide preparation program which culminates with the formulation of numerous requested short-lived radiopharmaceutical agents for clinical evaluation. The existence of two cyclotrons and the requests for cyclotron-produced radionuclides, principally short-lived positron-emitting ones, necessitates an efficient and cost-effective program. The clinical need for ^{15}O labelled water exemplifies the modification and effective coupling of two supplied gas target systems without detriment to either individual product. ^{15}O labeled oxygen, produced from the $^{14}N(d,n)^{15}O$ nuclear reaction, is combined with the target gas for ^{11}C labelled cyanide production through standard fittings to achieve the chemical oxidation. The system allows an on-line product of extremely high yield and excellent radionuclide purity. The operational characteristics of the redesigned commercial cyclotron targetry system and the radiochemical considerations are presented.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 27449, 27450, 27860, 27870, 28098

27893 **(AD-A—187688/7/XAB) Fuels-combustion research. Annual report, 10 October 1986-30 September 1987.** Dryer, F.L.; Glassman, I.; Williams, F.A. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 31 Oct 1987. 38p. NTIS, PC A03/MF A01.

After studying soot formation in normal diffusion flames, near and slightly sooting inverse diffusion flames were investigated to determine the key intermediates to soot formation. The results indirectly confirm that the initial number density of soot particles that form scale with aromatic formation just prior to soot inception. Correlations exist between a fuel's sooting tendency as measured by the Princeton smoke-height experiment and the extent of aromatic formation measured in both inverse and normal diffusion flames. Work on the oxidation of the aromatics present in jet propulsion fuels continues with th major effort directed at the dialkylated benzenes. The major study concerned the oxidation of para-xylene. The results indicate oxidation of one side chain at a time before the benzene ring is attached. There is a linear decay of the fuel and the major species detected were toluene, benzene, p-tolualdehyde, p-ethyltoluene and carbon monoxide. Kinetics steps leading to these intermediates are given. Combustion-property observations of isolated boron-alurry droplets were extended to in-house boron/JP-10 slurries with and without surfactants. The experimental results revealed that stabilizing agents are responsible for the violent disruption of the primary slurry droplet and strongly support the previously proposed hypothesis of the formation of the impermeable shell and subsequent disruption phenomena.

27894 **(AD-A—187881/8/XAB) Simulation of infrared spectra. Memorandum report, August 1986-April 1987.** Douglass, C.H.; Loda, R.T.; Nelson, H.H. (Naval Research Lab., Washington, DC (USA)). 20 Oct 1987. 88p. (NRL-MR—6077). NTIS, PC A05/MF A01.

Programs have been developed to simulate absorption and emission spectra of atmospheric and combustion-product species. The programs use tabulated constants of the molecules have been included. The calculated emission and absorption spectra can be compared to experimental spectra and can be used to predict spectral shifts due to isotopic substitution. Results for a variety of materials and conditions are presented.

27895 **(N—88-15790) Chemical reacting flows.** Mularz, E.J.; Sockol, P.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1987. vp. (NASA-CP—10003-SESS-3; E—3798-SESS-3; NAS—1.55:10003-SESS-3). NTIS, PC A04/MF A01.

Future aerospace propulsion concepts involve the combination of liquid or gaseous fuels in a highly turbulent internal air stream. Accurate predictive computer codes which can simulate the fluid mechanics, chemistry, and turbulence combustion interaction of these chemical reacting flows will be a new tool that is needed in the design of these future propulsion concepts. Experimental and code development research is being performed at Lewis to better understand chemical reacting flows with the long term goal of establishing these reliable computer codes. The approach to understanding chemical reacting flows is to look at separate simple parts of this complex phenomena as well as to study the full turbulent reacting flow process. As a result research on the fluid mechanics associated with chemical reacting flows was initiated. The chemistry of fuel-air combustion is also being studied. Finally, the phenomena of turbulence-combustion interaction is being investigated. This presentation will highlight research, both experimental and analytical, in each of these three major areas.

27896 **(N—88-15853) Effect of microgravity on flame spread over a thin fuel.** Olson, S.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1987. 49p. (NASA-TM—100195; E—3785; NAS—1.15:100195). NTIS, PC A03/MF A01.

A flame spreading over a thermally thin cellulose fuel was studied in a quiescent microgravity environment. Flame spread over two different fuel thicknesses was studied in ambient oxygen-nitrogen environments from the limiting oxygen concentration to 100 percent oxygen at 1 atm pressure. Comparative normal-gravity tests were also conducted. Gravity was found to play an important role in the mechanism of flame spread. In lower oxygen environments, the buoyant flow induced in normal gravity was found to accelerate the flame spread rate as compared to the microgravity flame spread rates. It was also found to stabilize the flame in oxidizer environments, where microgravity flames in a quiescent environment extinguish. In oxygen-rich environments, however, it was determined that gravity does not play an important role in the flame spread mechanism. Fuel thickness influences the flame spread rate in both normal gravity and microgravity. The flame spread rate varies inversely with fuel thickness in both normal gravity and in an oxygen-rich microgravity environment. In lower oxygen microgravity environments, however, the inverse relationship breaks down because finite-rate kinetics and heat losses become important. Two different extinction limits were found in microgravity for the two thicknesses of fuel. This is in contrast to the normal-gravity ex-

tinction limit, which was found to be independent of fuel thickness. In microgravity the flame is quenched because of excessive thermal losses, whereas in normal gravity the flame is extinguished by blowoff.

27897 **(PB—88-166806/XAB) Fundamental combustion research applied to pollution formation.** (Energy and Environmental Research Corp., Irvine, CA (USA)). Jan 1988. 1122p. NTIS, PC E99.

Set includes PB—88-166814 through PB—88-166830.

A separate abstract was prepared for the 3 parts of this volume.

27898 **(PB—88-166814/XAB) Fundamental combustion research applied to pollution formation. Volume 2a. Physics and chemistry of two-phase systems: flame-combustion processes.** Seeker, W.R.; Heap, M.P. (Energy and Environmental Research Corp., Irvine, CA (USA)). Jan 1988. 282p. NTIS, PC A13/MF A01.

See also Volume 1, PB—86-122660, and Volume 2B, PB—88-166822; Also available in set of 3 reports PC E99, PB—88-166806.

The reports included in the three-part volume describe eight studies by various investigators, to better understand the physics and chemistry of two-phase combustion with respect to pollution formation. Volume IIa describes mechanisms of fuel nitrogen processing in large-scale utility flames burning pulverized coal and heavy fuel oils, in three parts: (1) high-temperature decomposition and combustion of pulverized-coal (EERC); (2) detailed measurement of long pulverized coal flames for the characterization of pollutant formation (International Flame Research Foundation); and (3) heavy-oil combustion in shear layers (United Technologies Research Center).

27899 **(PB—88-166822/XAB) Fundamental combustion research applied to pollution formation. Volume 2b. Physics and chemistry of two-phase systems: devolatilization and volatile reactions.** Seeker, W.R.; Heap, M.P. (Energy and Environmental Research Corp., Irvine, CA (USA)). Jan 1988. 378p. NTIS, PC A17/MF A01.

See also Volume 2A, PB—88-166814, and Volume 2C, PB—88-166830; Also available in set of 3 reports PC E99, PB—88-166806.

The reports included in the three-part volume describe eight studies by various investigators, to better understand the physics and chemistry of two-phase combustion with respect to pollution formation. Volume IIb gives information on the influence of various combustion parameters (i.e., fuel type, stoichiometry, residence time, temperature, and mixing) on the fate of volatile fuel nitrogen, in four parts: (1) method for characterization of coal during thermal decomposition (United Technologies Research Center); (2) the volatility of fuel nitrogen species (Rockwell); (3) stirred-reactor study of pollutant formation from combusting pulverized-coal clouds (Acurex); and, (4) pollutant formation from combustion of fuel oils in a well mixed combustor (Battelle).

27900 **(PB—88-166830/XAB) Fundamental combustion research applied to pollution formation. Volume 2c. Physics and chemistry of two-phase systems: heterogeneous NO reduction.** Seeker, W.R.; Heap, M.P.; Tyson, T.J. (Energy and Environmental Research Corp., Irvine, CA (USA)). Jan 1988. 462p. NTIS, PC A20/MF A01.

See also Volume 2B, PB—88-166822; Also available in set of 3 reports PC E99, PB—88-166806.

The reports included in the three-part volume describe eight studies by various investigators, to better understand the physics and chemistry of two-phase combustion with respect to pollution formation. Volume IIc gives information on the kinetic rates and mechanisms of nitrogen oxide (NO) reduction on solid particles, in three parts: (1) trials on NO and NH_3, alumina, quartz, graphite and soot; (2) comparative study of coal and char; and (3) trials on flyashes and study of reactions involving hydrogen cyanide.

27901 **(PB—88-168968/XAB) Fundamental combustion research applied to pollution formation. Volume 3. Support studies: measurement studies. Final report, January 1977-September 1980.** Seeker, W.R.; Heap, M.P. (Energy and Environmental Research Corp., Irvine, CA (USA)). Feb 1988. 497p. NTIS, PC A21/MF A01.

See also Volume 4, PB—88-144001.

This report, one of four volumes describing research performed under EPA's Fundamental Combustion Research (FCR) Applied to Pollution Formation Program, gives results of three studies related to measurement-system evaluations. Section I documents an evaluation of the performance and potential measurement biases of chemiluminescent NOx analyzers. The study evaluates commercial instruments operating with low- and atmospheric-pressure reaction chambers. Section II documents an assessment of various techniques used to measure nitrogenous intermediates from staged-combustion processes. The study focuses on an evaluation of specific ion electrodes for measurement of hydrogen cyanide and ammonia concentrations generated in staged-combustion flames. Emphasis was on development of sampling techniques and evaluation of potential biases in specific ion-electrode analysis. Section III documents an evaluation of three laser-based techniques (based on interferometry, holography, and laser diffraction) for measuring characteristics of sprays. Results are presented from application of these techniques for measurement of droplet-size distribution produced by a commercial liquid-spray nozzle.

27902 **Combustion stability limits of coflowing turbulent jet diffusion flames.** Dahm, W.J.A.; Dibble, R.W. (Michigan Univ., Ann Arbor (USA); Sandia National Labs., Livermore, CA (USA)). pp 8 of Aerospace sciences meeting. Reno, NV; AIAA (1988). (AIAA-Paper—88-0538; CONF-880139—).

From 26. AIAA aerospace conference; Reno, NV, USA (10 Jan 1988).

Results from an experimental and theoretical investigation into the liftoff and blowout mechanisms in turbulent diffusion flames are presented. The blowout stability limits of coflowing turbulent jet diffusion flames are formulated in terms of a recently proposed flame stabilization mechanism based on the large scale organization of entrainment and mixing observed in turbulent shear flows. Results show that when the flame stability criterion is evaluated for the last large scale structure in the flame, consistent with the underlying physical picture for this stabilization mechanism, a large reduction in the blowout limit is expected for even a small coflow velocity. This phenomenon is experimentally verified, and good quantitative agreement is demonstrated with a set of measurements for the blowout limits of coflowing turbulent jet flames. The liftoff characteristics of such coflowing turbulent jet diffusion flames are also documented, and a possible relationship between the liftoff and blowout mechanisms is discussed. 20 references.

27903 **Calculation of low Mach number reacting flows.** Dwyer, H.A. (California Univ., Davis (USA)). pp 10 of Aerospace sciences meeting. Reno, NV; AIAA (1988). (AIAA-Paper—88-0640; CONF-880139—).

From 26. AIAA aerospace conference; Reno, NV, USA (10 Jan 1988).

A numerical method has been developed to calculate low Mach number and reacting flows in general and the burning and vaporization of a hydrocarbon droplet in particular. The method is time accurate and it makes use of the continuity equation to form a pressure correction. The basic transport equations have been formulated in finite volume form, and a very stable predictor/corrector algorithm has been employed. The continuity equation and pressure correction step have been solved to high accuracy with the use of a direct solver technique which also has the advantage of very good efficiency. The physical problem of the burning and vaporization of a high molecular weight hydrocarbon droplet is a very difficult one due to the very large temperature and density gradients in the flow, and also due to the complicated flow structures which develop during a droplet's lifetime. The methods used in this research have successfully solved these problems, and a detailed history of the droplet has been calculated and studied. 35 references.

42 ENGINEERING

REFER ALSO TO CITATION(S) 27624

27904 **(PB—88-170022/XAB) NBS (National Bureau of Standards) research reports, December 1987.** (National Bureau of Standards, Washington, DC (USA)). Dec 1987. 37p. (NBS/SP—735). NTIS, PC A03/MF A01.

Also available from Supt. of Docs. See also PB—88-170030; Library of Congress catalog card No. 87-619882.

Contents include: Research update; Back to the basics; Will the Japanese beat the United States in superconductivity; Low-resistance contacts developed for high-temperature superconductivity; IGES--translating electronic tongues; Lifting-system failure probable cause of fatal building collapse; Six NBS projects win 1987 I-R 100 awards; Matching processor and algorithms--the challenge of parallel computers; Process sensor measures internal temperatures in extruded aluminum: Life, death, and oxygen radicals; New technique for evaluating installation of home insulation; New publications; Conference calendar.

27905 **(PB—88-170030/XAB) NBS (National Bureau of Standards) research reports, August 1987.** (National Bureau of Standards, Washington, DC (USA)). Aug 1987. 37p. (NBS/SP—733). NTIS, PC A03/MF A01.

Also available from Supt. of Docs. See also PB—88-170022 and PB—87-210258; Library of Congress catalog card No. 87-619861.

Contents: Research update; Riding a heat wave - researchers take another look at superconductivity; President Reagan announces superconductivity initiative; Life on the edge: measuring linewidths; Thin-film thermocouples designed for diesel engine research; Concrete research at NBS--new ways to understand an old material; Improved clinical lab tests: goal of cooperative program; Emerging technologies--the competitive edge of the future(question mark); High-technology bugs are new tools for science and industry; New publications; Conference calendar.

27906 **(PB—88-171756/XAB) IHI (Ishikawajima-Harima Heavy Industries) Engineering Review, Vol. 27, No. 6, November 1987.** (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1987. 76p. NTIS, PC E04.

Text in Japanese with English abstracts. See also PB—88-171764 through PB—88-171772 and PB—88-225488.

Contents include: Development of molten carbonate fuel cell - result of 10-kW class stack test; Development of visual welding sensors and feedback control of molten pool; Development of IHI wide-range pulverized-coal burner; Design and fabrication of Kita Bisan-Seto Bridge stiffening truss for Honshu-Shikoku Bridge Authority; In-cell crane and repair hoist for Power Reactor & Nuclear Fuel Development Corporation; Development of voice alarm system for ships machinery part alarm.

27907 **(PB—88-901800/XAB) Government Research and Development Summaries: Mechanical Project Briefs. Monthly report.** (CSR, Inc., Washington, DC (USA). Power Information Center). 1988. ap. NTIS Subscription.

Supersedes PB—87-901800; Paper copy available on subscription $100.00/year. U.S. sales only, excluding embassies. Additional subject categories available at a discount. Also available in single copies.

Mechanical Project Briefs describe the status of all R&D programs submitted to the Power Information Center by the government sponsors in energy conversion to mechanical hydraulic, and pneumatic energy, including working fluids, materials, heat transfer processes, heat transfer and storage equipment, and other components of mechanical-conversion systems. The document is not to be reproduced, in whole or in part, for dissemination outside your own organization nor may it be reproduced for advertising or sales promotion purposes.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 27481, 27507, 27529, 27585, 27606, 27732

27908 **(AD-A—187833/9/XAB) Composite ceramic superconducting filaments for superconducting cable. Interim progress report, 16 August-15 October 1987.** Halloran, J.W. (Ceramics Process Systems Corp., Cambridge, MA (USA)). 13 Nov 1987. 45p. NTIS, PC A03/MF A01.

This is the first progress report of a five-month program to demonstrate the feasibility of manufacturing superconducting wires from YBa_2Cu_3O/sub 7-x/, consisting of a small ceramic core with a copper cladding. The critical current will be enhanced by creating a <010> fiber texture in the ceramic using a combination of green-particle orientation and controlled recrystallization. The ceramic core will be manufactured by solution dry-spinning of a mixture of the superconducting ceramic powder with appropriately chosen polymers, solvents, and additives. The dry-spun fibers will be sintered and then clad with copper or other metals by electroplating, or mechanical cladding. The objectives of the program are to demonstrate the dry-spinning process, the sintering, and the cladding process, and to determine the effect of microstructural texturing on the critical current. The electrical and physical properties of the filaments are to be characterized. The process for synthesizing YBa_2Cu_3O/sub 7-x/ from copper oxide, yttrium oxide, and barium carbonate has been scaled up and improved. Problems involving retention of the barium carbonate have been overcome, and a sinterable powder is prepared after a single calcination reaction at 800°c. The powder readily sinters to around 94% of theoretical density.

27909 **(AD-A—188014/5/XAB) Quantum limits of superconducting heterodyne receivers. Annual technical report, 15 May 1986-14 May 1987.** Richards, P.L. (California Univ., Berkeley (USA). Dept. of Physics). 7 Oct 1987. 5p. NTIS, PC A02/MF A01.

The goal of this research is to produce quantum-limited SIS quasi-particle heterodyne receivers at submillimeter wavelengths. The approach is to compare the performance of waveguide and planar lithographed quasi-optical SIS mixers in W-band (lambda approx. 3mm) in order to understand the factors which upgrade the performance of the latter. This information will be used to optimize the planar quasi-optical mixers. Finally, these optimized designs will be scaled to submillimeter wavelengths. Systematic tests of both types of mixers were carried out during the second grant year. Improved designs of planar quasi-optical mixers were designed and fabricated. The construction of test apparatus for submillimeter wavelengths has begun.

27910 **(AD-A—188025/1/XAB) Cryocooler systems demonstration. Final report, 4 September 1984-23 February 1986.** Sandell, R.D.; Silver, A.H. (TRW Space and Technology Group, Redondo Beach, CA (USA)). 31 Aug 1987. 25p. NTIS, PC A03/MF A01.

TRW successfully transferred Stirling-cycle cryocooler technology from its development at NBS to industry. They installed, modified, and operated a small, plastic, five-stage Stirling cycle refrigerator developed at the National Bureau of Standards and furnished to TRW for this project. Also designed and fabricated was a new gas handling system, pressure-wave generator and displacer drive, and fiber-designed, fabricated, and operated a monolithic thin-film SQUID gradiometer on a single silicon chip. The cooler was modified by the addition of a 4 kelvin Joule-Thompson stage before delivery to TRW and we initially fabricated this SQUID with a Nb-Pb technology for 4 kelvin experiments. We later transferred to an all-niobium technology developed at TRW when it was decided to operate the cryocooler at about 7°K without the Joule-Thomson stage. TRW designed, constructed, and installed all components necessary to interface the magnetometer with the silicon printed-circuit board which was heat-sunk to the final stage of the cryocooler. Radiation shields were constructed and low-noise and low-thermal electrical leads were provided.

27911 (AD-A—188186/1/XAB) Overview of vision-based navigation for autonomous land vehicles 1986. Technical report. Chandran, S.; Davis, L.S.; Dementhon, D.; Dickenson, S.J.; Gajulapalli, S. (Maryland Univ., College Park (USA). Center for Automation Research). Apr 1987. 126p. (CAR-TR—285). NTIS, PC A07/MF A01.

This report describes research performed during the first two years on the project Vision-Based Navigation for Autonomous Vehicles being conducted under DARPA support. The report contains discussion of four main topics: (1) Development of a vision system for autonomous navigation of roads and road network. (2) Support of Martin Marietta Aerospace, Denver, the integrating contractor on DARPA's ALV program. (3) Experimentation with the vision system developed at Maryland on the Martin Marietta ALV, and (4) Development and implementation of parallel algorithms for visual navigation on the parallel computers developed under the DARPA Strategic Computing Program--specifically, the WARP systolic array processor, the Butterfly, and the Connection Machine.

27912 (AD-A—188370/1/XAB) Perspectives in microclimate cooling involving protective clothing in hot environments. Speckman, K.L.; Allan, A.E.; Sawka, M.N.; Young, A.J.; Muza, S.R. (Army Research Inst. of Environmental Medicine, Natick, MA (USA)). Sep 1987. 73p. NTIS, PC A04/MF A01.

The effectiveness of microclimate cooling systems in alleviating the thermal burden imposed upon soldiers by the wearing of chemical protective clothing under varying environmental conditions was examined in a series of studies conducted by the U.S. Army Research Institute of Environmental Medicine on the copper manikin, in the climatic chambers and in the field. Liquid-cooled undergarments (LCU) and air-cooled vests (ACV) were tested under environmental conditions from 29 C, 85% rh to 52 C, 25% rh. These parameters were chosen to stimulate conditions that may be encountered in either armored vehicles or in desert or tropic climates. The authors reviewed seven studies using LCU (including two ice-cooled vests) and six studies using ACV. LXU tests investigated the effect on cooling when the proportion of total skin surface covered by the LCU was varied. ACV tests examined the effects on cooling during different combinations of air temperature, humidity, and air-flow rates. Additionally, these combinations were tested at low and moderate metabolic rates. The findings from these LCU and ACV studies demonstrate that a) cooling can be increased with a greater body-surface coverage by an LCU, and b) evaporative cooling with an ACV is enhanced at low metabolic rates with optimal combinations of air-flow rates and dry bulb/dew point temperatures, resulting in the extension of tolerance time. The application of these findings to industrial work situations is apparent.

27913 (AD-A—188401/4/XAB) Chemical-defense flight-glove ensemble evaluation. Final report, June 1986-February 1987. Ross, J.; Ervin, C. (Anthropology Research Project, Inc., Yellow Springs, OH (USA)). Jun 1987. 47p. NTIS, PC A03/MF A01.

Four chemical-defense flight-glove ensembles were evaluated for their effect on manual dexterity. Two- and three-layer combinations included in the study were: cotton liner/7-mil butyl/Nomex; cotton liner/12.5-mil epichlorohydron butyl/Nomex; Nomex/7-mil butyl (no liner); and, Nomex/12.5-mil epichlorohydron butyl (no liner). Fifteen male and 15 female subjects performed five dexterity tests bare-handed and while wearing each of the glove ensembles. Results indicated that, as expected, all gloved conditions produced significantly poorer performances that did the bare-handed condition, and two-layer combinations resulted in consistently better performances that did the three-layer combinations. Although subjects' performance were least impaired by the Nomex/butyl 7 combination, the butyl 7 gloves tended to tear. For this reason, the two-layer combinations of Nomex/epichlorohydron butyl 12.5 appears to be the most practical ensemble.

27914 (AD-A—188798/3/XAB) Review of quantitative fit testing in aircrew applications for standardization purposes. Technical note. Meunier, P.P. (Defence Research Establishment, Ottawa, Ontario (Canada)). Jan 1987. 28p. (DREO-TN—87-17). NTIS, PC A03/MF A01.

The primary objective of any nuclear, biological, and chemical (NBC) respirator is to provide the wearer with the maximum degree of protection. Ideally, a respirator should provide no breathing resistance and total protection against NBC agents. In practice, though, target-protection-factor values are specified which are mainly based on threat scenarios, and are standardized within NATO for both ground forces (1) and aircrew. Higher standards of protection are required for aircrew because of the very small quantity of nerve agent that is required to cause myosis and incapacitate aircraft pilots (2). The accuracy of the evaluation of the protection afforded becomes extremely important not only in the certification process of any respirator considered for NBC defence but also in training the users to obtain the best fit. The purpose of this paper is to review quantitative-fit test methods and their limitations concentrating primarily on sodium chloride and corn oil aerosols and to provide guidelines that would help standardize these systems.

27915 (AECL—8843) Reliability study of the CRNL off-site power supply. Winfield, D.J.; Adams, S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1985. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702209/JAW.

Recommended values for various probabilistic parameters related to the CRNL off-site power supply have been derived from historical data. The off-site power failure probability density has been represented by a continuous analytical distribution which can be approximated by either an exponential or a Weibull probability density function. The off-site power outage time probability was found to be well represented by using either a Weibull or a lognormal probability density function.

27916 (N—88-15924, pp vp) Air Force cryocooler development for spacecraft. Haskin, W.L. Sep 1987. NTIS, PC A17/MF A01. (NASA-CP—10001; E—3732; NAS—1.55:10001; CONF-8704284—).

From Cryogenic fluid management technology workshop; Cleveland, OH, USA (28 Apr 1987).

An overview is given of Air Force sponsored cryocooler development for long duration spacecraft missions. Alternate approaches are being pursued to insure eventual success. The types of closed cycle cryocoolers that are now in advanced development include Vuilleumier, turbo-Brayton, and rotary-reciprocating refrigerators. Linear Stirling coolers with magnetic bearings have also been jointly sponsored by NASA and the Air Force. Technology is also being explored for future coolers using magnetic materials at low temperatures and for refrigerators with sorption compresssors. All of these cryocoolers are presently configured primarily for use with infrared sensor systems, but the designs could be adapted for use with cryogenic fluid storage systems or other applications.

27917 (PB—88-160742/XAB) Design, optimization, and construction of a d-c SQUID with complete flux-transformer circuits. Knuutila, J.; Kajola, M.; Seppae, H.; Mutikainen, R.; Salmi, J. (Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.). Oct 1987. 28p. (TKK-F-A—619). NTIS, PC E03/MF A01.

The design of a complete dc SQUID (Superconducting Quantum Interference Device) with a flux transformer input circuit is discussed. The flux-coupling circuits introduce a substantial capacitance across the SQUID and give rise to many resonances which may couple strongly to the SQUID dynamics. Both effects lead to multiple modes in the SQUID dynamics and, consequently, to excess noise. For a low-noise SQUID with smooth characteristics, the analysis and practical considerations suggest signal coupling via an intermediary transformer. The method allows simultaneously optimization of the SQUID parameters, minimizing the parasitic capacitance, control over the resonances, and good inductance matching to practical magnetometer coils. A model is developed to optimize the structure; it describes the whole circuit with the help of a suitably modified autonomous SQUID, provided that the system is free from multiple modes due to resonances or large parasitic capacitance. Following these design principles, a dc SQUID was built. The fabrication of the SQUID and the high-quality electronics especially suitable for multiple-SQUID devices are presented.

27918 **(PB—88-858493/XAB) Computer-aided design: buildings and building systems. January 1970-February 1988 (citations from the NTIS data base). Report for January 1970-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 66p. NTIS PC N01/MF N01.

Supersedes PB—86-873908.

This bibliography contains citations concerning the utilization of computer analyses in architectural and engineering studies of buildings and associated building systems. Topics include analyses of structural members under various load conditions, heating and cooling system design, seismic evaluations, and economic factors. Specific software packages are described. (This updated bibliography contains 126 citations, 20 of which are new entries to the previous edition.)

27919 **(PB—88-860119/XAB) Space shuttle: thermal-protection systems. January 1972-March 1988 (Citations from the NTIS data base). Report for January 1972-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 138p. NTIS PC N01/MF N01.

Supersedes PB—85-865376.

This bibliography contains citations concerning the design, development, and evaluation of the reusable surface insulation (RSI), or the-rmal protection system (TPS), for the space shuttle. Topics include a discussion of the properties of the insulation at room temperature, attachment systems for the tiles, environmental effects on the TPS, and methods for repairing surface damage to the glass-coated porous refractory material used in the TPS. (This updated bibliography contains 304 citations, 58 of which are new entries to the previous edition.)

27920 **(SAND—87-2200C) The nonlinear dynamics of a spacecraft coupled to the vibration of a contained fluid.** Peterson, L.D.;Crawley, E.F.;Hansman, R.J. (Sandia National Labs., Albuquerque, NM (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Aeronautics and Astronautics). 1988. Contract AC04-76DP00789. 38p. (CONF-880483—1).

From 29. structures dynamics and materials conference; Williamsburg, VA, USA (18 Apr 1988).

The dynamics of a linear spacecraft mode coupled to the nonlinear low gravity slosh of a fluid in a cylindrical tank is investigated. Coupled, nonlinear equations of motion for the fluid-spacecraft dynamics are derived through an assumed mode Lagrangian method. Unlike linear fluid slosh models, this nonlinear slosh model retains two fundamental slosh modes and three secondary modes. An approximate perturbation solution of the equations of motion indicates that the nonlinear coupled system response involves fluid-spacecraft modal resonances not predicted by either a linear or a nonlinear, uncoupled slosh analysis. An experiment was developed to verify and compliment this analysis. Scale model fluid tanks were coupled to an electromechanical analog for the second order oscillatory spacecraft mode. Moderate and low gravity were investigated in 1-g using capillary scale models, and zero gravity was investigated on the NASA KC-135 Reduced Gravity Test Facility. The experimental results substantiate the analytical predictions. The dependence of the coupled nonlinear response on the coupled system parameters and the gravity level is illustrated and discussed.

27921 **(SAND—87-2446C) Recertification of a high pressure vessel using nondestructive evaluation techniques.** Roach, D.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 20p. (CONF-880661—2).

From ASME pressure vessel and piping conference; Pittsburgh, PA, USA (19 Jun 1988).

In an effort to meet both testing demands and budget constraints, the Structural Mechanics Lab at Sandia National Laboratories purchased a used high pressure vessel (working pressure 40 ksi). At the time this investigation began, the vessel had been out-of-service for ten years. This paper describes a series of nondestructive techniques (NDT) which were used to assess the fitness of the vessel and to recertify its original pressure rating. Dye penetrant and ultrasonic inspections and an overpressure test with acoustic emission monitoring were all used to assure the structural integrity of the vessel. The design and installation of a new sealing system, necessitated by the deterioration of the original system, is also presented. By combining the NDT evaluation process with a sealing system configured to suit experimental applications, it was possible to salvage the vessel for continued use. This resulted in a substantial savings of time and money versus the purchase of a new vessel with similar capabilities. 12 refs., 8 figs., 1 tab.

27922 **Hyperbolic two-pressure models for two-phase flow revisited.** Ransom, V.H.; Hicks, D.L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* **75**: No. 2, 498-504(Apr 1988).

This paper presents correction to a previous paper (J. Comput. Phys. 53 (1984). 124) on stability analyses of one-pressure models for two-phase flow. It also presents some extensions and generalization of previous work on two-pressure models. The extensions allow both the slopes to the interfaces and the rates of mass transfer through the interfaces to be non-negligible. These enlargements of the domain of applicability of the two-pressure models introduce extra derivative terms into the models. These extra derivative terms do not change the basic character of the model. The two-pressure models remain stable in the sense of von Neumann a.e. in state space with the more complete modeling of the interface. copyright 1988 Academic Press, Inc.

27923 **Thermal measurements in large pool fires.** Gregory, J.J.; Keltner, N.R.; Mata, R. Jr. (Thermal Test and Analysis Div., Sandia National Labs., Albuquerque, NM (USA)). pp 27-36 of Heat and mass transfer in fire. Kulkarni, A.K.; Jaluria, Y. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—). Contract AC04-76DP00789.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

During the summer of 1983, a series of pool fire tests was conducted in which the test item was 1.4 m diameter, 6.4 m long, mild steel calorimeter with a mass of approximately 10,000 kg. The purpose of these tests was to study the thermal response of a large test item in a specified fire configuration, to define thermal boundary conditions, and to assess the repeatability of the fire environment. The calorimeter was used to simulate a nuclear waste transportation cask.

27924 **An experimental and analytical evaluation of a type B radioactive transport container.** Moya, J.L.; Akau, R.L. (Sandia National Labs., Albuquerque, NM (USA)). pp 37-44 of Heat transfer problems in nuclear waste management. McAssey, E.V.; Schrock, V.E. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—). Contract AC04-76DP00789.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

A thermal test of the Beneficial Uses Shipping System (BUSS) cask containing irradiation source capsules was conducted to verify a two-dimensional axisymmetric thermal model developed for the Safety Analysis Report. The BUSS cask is a Type B package developed to transport irradiation source capsules of cesium chloride or strontium fluoride to commercially licensed food and pharmaceutical irradiating facilities. The Uniqueness of this test is that it was performed on an internally instrumented, full-scale cask with actual radioactive capsules. This results in more realistic system temperatures than those obtained if heaters were used to simulate the large gamma source. In addition, the thermal test provides benchmark data for other thermal codes.

27925 **Annihilation of vortex-antivortex pairs in a superconducting shield.** Fang, M.M. Ames, IA; Iowa State Univ. (1986). 95p. University Microfilms Order No. 87-03,703.Contract W-7405-ENG-82.

Thesis (Ph. D.).

A new type of magnetic shielding device was constructed for use in superconducting microelectronic applications where low ambient magnetic field is desirable. The shield was a specially designed superconducting thin film in the shape of a long cylindrical tube with a low pinning material in the central region and high flux pinning regions at the end. It was shown that magnetic flux perpendicular to the axis of a cylinder could be swept out of the interior

of the shield by moving vortex-antivortex pairs to one side of the shield where they annihilate. The flux-sweeping properties of the shield were found to work well in a small-temperature window close to the transition temperature where the critical current for depinning vortices was less than the critical current for the formation of hot spots. Once the vortices are swept out, the shield can be cooled to enhance the Meissner shielding effects against other stray fields. In the course of designing and testing the shield, a systematic study of flux pinning was made for the low magnetic field regime between 1 mOe and 30 Oe.

4203 Lasers

REFER ALSO TO CITATION(S) 27967, 27968, 28471, 28658

27926 (AD-A—187694/5/XAB) Diode-pumped fiber laser. Final report, September 1984-December 1986. Cordova-Plaza, A.C.; Digonnet, M.J.; Fesler, K.A.; Gaeta, C.J.; Ping, S. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Aug 1987. 226p. NTIS, PC A11/MF A01.

Q-switching in Nd:YAG fibers was investigated as a particularly interesting technique to generate narrow pulses in miniature solid-state lasers. Laboratory models of both mechanically and passively Q-switched Nd:YAG fiber lasers were developed and characterized. The devices were made of a short length of end polished fiber placed between two miniature laser mirrors and optically end-pumped with a dye laser. Mechanical Q-switching, achieved by modulating the orientation of one of the mirrors, led to the generation of pulse trains with 50-mW peak power and 70-nsec-wide individual pulses. The pulse-train structure was explained by the slow nature of the switching mechanism, and quantitatively predicted by a novel slow Q-switching theoretical model. Passive Q-switching was realized in practice by placing a thin film of saturable absorber in the fiber-laser cavity, thereby preserving the miniature character of the device. A record pulse width of 6 nsec and peak power of 2 watts were observed in state-of-the-art, Nd:YAG waveguiding fibers, which is the first report of nonsecond pulse generation in single crystal fibers.

27927 (AD-A—187997/2/XAB) Tapered wiggler analysis of high-gain free-electron-laser oscillators. Interim report. Marable, W.P.; Tang, C.M.; Sprangle, P. (Naval Research Lab., Washington, DC (USA)). 12 Dec 1987. 35p. (NRL-MR—5854). NTIS, PC A03/MF A01.

The development of lasers in which the active medium is a relativistic stream of free electrons has evoked much interest. The prospect of operating these continuously tunable, high-gain devices at high efficiencies by appropriately tapering the wiggler-field parameters has significantly increased the interest in these devices. Variable-parameter wiggler free-electron lasers have been previously considered for operation in the amplifier configuration and also in the micropulse, low-gain operation in the oscillator configuration. The present analysis extends the range of application to the case of intense, long-pulsed electron beams in which the self-consistently derived space-charge potential (arising from the axial bunching of the particles in the beat wave) is not negligible. Also included in this analysis are arbitrarily relativistic beams (i.e., no ultrarelativistic beam approximation). We have obtained theoretical expressions for nonlinear efficiency and present a comparison of these results with a fully nonlinear simulation.

27928 (AD-A—188030/1/XAB) Development of a novel laser material for miniaturized laser system. Quarterly technical report No. 1, 1 April-30 June 1981. Zwicker, W. (Philips Labs., Briarcliff Manor, NY (USA)). Jul 1981. 31p. NTIS, PC A03/MF A01.

Growth experiments have continued on crystals of NdP_5O_{14} (NPP) and $NdLiP_4O_{12}$(LNP). Laser rods are now being fabricated from large NPP crystals of excellent optical quality. Top seeding experiments on LNP crystals produced single crystals up to 1 cm in size; however, the optical quality was poor, presumably due to inhomogeneities of the fluxed melt. The growth setup is being changed to overcome this problem. Emission spectra of Nd in NPP, LNP, and NAB crystals have been recorded at both room and liquid-nitrogen temperatures. Together with the absorption spectra, these measurements gave the emission cross sections of the Nd^{3+} ions in these crystals. Using the emission cross sections and the fluorescence lifetime values measured previously, rough comparisons were made of the laser-performance parameters of the three crystals. Using the experimental laser setup described in the previous quarterly report, output energy versus electrical input energy characteristics of the NdPP laser were obtained for various mirror and cavity configurations. Approximate efficiencies of the laser pumping system were calculated. Fabrication of a miniature laser with optimum output is being seriously hindered by the lack of proper-size miniature flash lamps (2-3 mm O.D. and 15-20 mm arc length).

27929 (AD-A—188090/5/XAB) Coherent laser addition using binary phase gratings. Leger, J.R.; Swanson, G.J.; Veldkamp, W.B. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 Oct 1987. 10p. (JA—5940). NTIS, PC A02/MF A01.

Pub. in Applied Optics, Vol. 26, No. 20, 4391-4399(15 Oct 1987).

Binary-phase diffraction gratings are shown to couple light coherently from a laser array into a single on-axis beam. The diffraction grating, designed to split a single beam into a specific number of equal-intensity diffraction orders, is placed inside the cavity formed by the laser array and a common-output mirror. The grating superimposes the light beams from the lasers in the array and produces a far-field pattern with the same divergence as that of a single laser. Six GaAlAs lasers from an antireflection-coated linear array were combined with a coupling efficiency of 68.4%. The far field of the combined GaAlAs lasers consisted of a single on-axis Gaussian beam.

27930 (AD-A—188292/7/XAB) Monolithic two-dimensional surface-emitting arrays of GaAs/AlGaAs diode lasers. Donnelly, J.P.; Goodhue, W.D.; Windhorn, T.H.; Bailey, R.J.; Lambert, S.A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 12 Oct 1987. 4p. (JA—6009). NTIS, PC A02/MF A01.

Pub. in Applied Physics Letter, Vol. 51, No. 15, 1138-1140(12 Oct 1987).

Monolithic two-dimensional arrays with light emission normal to the surface were obtained by fabricating edge-emitting quantum well GaAs/AlGaAs lasers with deflecting mirrors adjacent to both laser facets. The facets and mirrors were formed by ion-beam-assisted etching. Proton bombardment between adjoining lasers was used to prevent lasing in the transverse direction. At the highest pulsed current used in these experiments, 10.5 A, the power output of a 22-element array was 1.6 W, which corresponds to a power density of 160 W/sq.cm. At this level, the power output was still linear with current.

27931 (AD-A—188428/7/XAB) Discharge excitation of dye vapors. Final report, July 1986-July 1987. Eden, J.G. (Illinois Univ., Urbana (USA). Dept. of Electrical and Computer Engineering). Sep 1987. 10p. NTIS, PC A02/MF A01.

Experiments were conducted to assess the feasibility of obtaining a discharge-pumped dye-vapor laser. A 15 (or 50)-cm active-length, UV-preionized device was developed that exhibits a specific power loading of the medium of approx. 5 MW - /cm-1/cc and will operate continuously at temperatures exceeding 400 C. Recently, hydrogen thyratron switching of the device and corona preionization were installed to minimize jitter and dye fragmentation. Optimization of the rare gas/N_2 diluent mixture was completed and fragmentation studies for several dye molecules were conducted. POPOP and alpha-NPO are excellent in the latter regard but Coumarin 6 rapidly decomposes in the discharge environment. The fluorescence efficiency of alpha-NPO is only 40% of that for POPOP under comparable conditions. BBO and PBBO are similar in structure and molecular weight to POPOP and appear to be excellent candidates for discharge excitation. Fluorescence and small signal-gain measurements are in progress.

27932 (AD-A—188454/3/XAB) Fiber-coupled external-cavity semiconductor high-power laser. Report for January-December 1986. Rediker, R.H.; Anderson, K.K.; Liew, S.K.; Corcoran, C.J. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Jan 1987. 6p. NTIS, PC A02/MF A01.

The 1985 annual report described the high spectral purity of the output from an ensemble of five discrete diode lasers when operated c-w. The linewidth of the c-w output of this external-cavity-controlled ensemble of diode lasers was shown to be less than 7.5 MHz (approx 2 x 10^{-8} power of the center frequency). Also reported was high-spectral-purity pulsed output from this external-cavity-controlled laser. In 1986, the pulsed operation of this laser was investigated in detail both experimentally and theoretically. Linewidths of the order of the 7.5-MHz instrument resolution were obtained. To achieve this high spectral purity in a pulse mode of operation, three alternate gain elements are operated cw and the intermediate two elements are pulsed. For a coherent ensemble of only three alternate gain elements, the spacing between the major-intensity maxima in the Fourier plane (the filter plane) is decreased by a factor of 2 relative to the spacing with all five elements operating coherently. As a result, the lasing threshold of the three-element ensemble is much higher because significant radiation hits the opaque areas of the filter. A calculation of the single-pass filter transmission of this case yields a value of 0.48 as compared to the transmission of 0.92 when all five elements are running.

27933 (AD-A—188602/7/XAB) Performance of a conduction-cooled Nd:glass slab laser. Reed, M.K.; Byer, R.L. (Stanford Univ., CA (USA). Dept. of Applied Physics). 1987. 7p. NTIS, PC A02/MF A01.

Pub. in SPIE (Society of Photo-Optical Instrumentation Engineers), Vol. 736, 38-44(1987).

The zig-zag slab geometry is an established method of reducing thermo-optical effects in solid-state lasers. Achieving predicted improvements requires careful control of the slab temperature distribution. The authors conduction-cooled zig-zag laser design is an attempt to provide a Nd:glass slab with uniform pumping and cooling within a protective environment. This paper reports the results of initial tests of this design.

27934 (AD-A—188676/1/XAB) Sinusoidal and digital high-speed modulation of p-type substrate mass-transported diode lasers. Tsang, D.Z.; Liau, Z.L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Mar 1987. 7p. (JA—5920). NTIS, PC A02/MF A01.

Pub. in Jnl. of Lightwave Technology, Vol. LT-5, No. 3, 300-304(Mar 1987).

The modulation characteristics of GaInAsP diode lasers grown on p-type substrates have been studied on devices in which the parasitic bonding pads have been eliminated. The lasers have thresholds as low as 4.5 mA. The small-signal sinusoidal response is comparable to similar lasers made on n-type substrates. A small-signal -3-dB frequency as high as 16.4 GHz has been measured with a 175-micrometer-long laser. The laser responds to large-signal digital word sequences at rates of 16 Gbit/s.

27935 (PB—88-159207/XAB) Uv preionized excimer laser. Eura, T.; Goto, J.; Onishi, Y.; Sato, Y.; Haruta, K. (Mitsubishi Electric Corp., Tokyo (Japan)). 1987. 5p. (In Japanese). NTIS, PC E04.

Included in Mitsubishi Denki Giho, Vol. 61, No. 9, 46-49(1987).

An excimer laser with high efficiency and high output power in the long-wavelength ultraviolet region was developed. The use of ultraviolet preionization and a capacitor-charge transfer type excitation circuit has enabled average output powers of 40W with KrF gas composition and over 20W with ArF. An automatic power-control system is used to achieve the stability required for industrial use. The article describes the structure of the prototype laser, the principles of operation, its operational characteristics, and performance.

27936 (PB—88-161583/XAB) Lasers: invention to application. Final report. Ausubel, J.H.; Langford, H.D. (National Academy of Engineering, Washington, DC (USA)). Aug 1987. 142p. NTIS, PC A07/MF A01.

Library of Congress catalog card No. 87-042941; Color illustrations reproduced in black and white.

Contents include: The laser--still young at 25; Lasers in modern industries; Lasers in communications and information processing; Lasers in medicine; Lasers in science; Interactions between the science and technology of lasers; Glossary.

27937 (PB—88-859137/XAB) Carbon dioxide lasers. September 1980-February 1988 (Citations from the NTIS data base). Report for September 1980-February 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 159p. NTIS PC N01/MF N01.

Supersedes PB—87-853982.

This bibliography contains citations concerning theory, design, operation, output, and diagnostics of CO_2 lasers. Included are studies relating to excitation, frequency conversion, modulation, laser pumping, reaction kinetics, gas dynamics, and plasmas. The development and efficiency of optical components, such as mirrors, resonators, tuning devices, infrared optical materials, amplifiers, and gratings are also discussed. (This updated bibliography contains 350 citations, 40 of which are new entries to the previous edition.)

27938 (PB—88-859160/XAB) Carbon dioxide waveguide lasers. January 1972-February 1988 (Citations from the International Aerospace Abstracts data base). Report for January 1972-February 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 116p. NTIS PC N01/MF N01.

Supersedes PB—85-867158; U.S. sales only.

This bibliography contains citations concerning the design, development, and applications of carbon dioxide waveguide lasers. The performance characteristics, including operational modes and pulse energies, are considered. (This updated bibliography contains 266 citations, 43 of which are new entries to the previous edition.)

27939 Frequency chirping of the free-electron laser. Moore, G.T. (Center for Advanced Studies, Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131). *Physical Review Letters;* **60**: No. 18, 1825-1827(2 May 1988).

Pulsed free-electron lasers in which there is a dependence of the electron energy on the time of injection into the wiggler are expected to produce wide bandwidth but coherent chirped optical pulses with unique characteristics. Such pulses could be compressed in a dispersive medium to lengths on the order of a few optical periods. Chirping should also produce enhanced efficiency in the high-power trapped-particle regime.

27940 Broad spectral features in the stimulated emission pumping spectrum of acetylene. Pique, J.P.; Engel, Y.M.; Levine, R.D.; Chen, Y.; Field, R.W.; Kinsey, J.L. (Laboratoire de Spectrometrie Physique, Universite Scientifique et Medicale de Grenoble, BP 87, 38402 Saint Martin d'Heres, Cedex, France). *Journal of Chemical Physics;* **88**: No. 9, 5972-5974(1 May 1988).

The vibrational spectrumof acetylene is reported. This is the stimulat emission pumping spectrum obtained by stimulated downward transition from an upper electronic state to the ground electronic surface.Broad band and high resolution spectra were recorded at 25840-27250 wave numbers.(AIP)

27941 Phased array concepts for free-electron lasers. Chow, W.W.; Saxman, A.C.; McVey, B.; Appert, Q.; Bender, S. (Hughes Aircraft Company, 1600 Randolph Court, SE, Albuquerque, New Mexico 87106). *Applied Optics;* **27**: No. 8, 1370-1370(15 Apr 1988).

A phased array scheme for free electron lasers is described which combines a frequency-locked array with a telescope array to combine laser beams constructively in one spot in the far field. (AIP)

27942 Multiple parallel RF excited CO/sub 2/ lasers. Chenausky, P.P.; Laughman, L.M.; Drinkwater, E.H. (to Secretary of the Army, Washington, DC). US Patent 4,719,640. 12 Jan 1988. Filed date 1 Aug 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

Twin laser apparatus of the waveguide type is described comprising a block of ceramic material having a pair of oppositely-disposed flat parallel surfaces; a pair of slots formed in one of the pair of block surfaces, the slots being parallel to each other and extending between the ends of the block; a first flat metallic electrode disposed on the one surface of the block and covering both of the slots and a second flat electrode disposed on the other surface of the pair of block surfaces, so that each of the slots cooperates with the first electrode to form a separate laser cavity, the first electrode having at least one recessed portion formed therein extending between and communicating with the pair of slots to form a connecting channel between the slots and at least one recessed portion formed in the first electrode providing a preferential initial breakdown of a lasing gas in the connecting channel which forces simultaneous initiation of a lasing discharge in both of the laser cavities; means for coupling the first and second electrodes to a source of RF excitation.

27943 Modeling laser ablation and fragmentation of renal and biliary stones. Gitomer, S.J.; Jones, R.D. (Applied Theoretical Physics Div., Los Alamos National Lab., Los Alamos, NM 87545 (USA)). pp 117 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Laser ablation and fragmentation of renal and biliary stones in vitro and in vivo has been successfully demonstrated. Laser light incident upon the stone appears to produce a plasma which generates a shock wave that propagates through the stone fracturing it. The elucidation of the physical mechanisms which are important in this laser-matter interaction is the subject of this research. The LASNEX computer code was used in the modeling. The code solves the coupled hydrodynamic and radiation transport equations in one or two dimensions and includes laser light absorption either via inverse bremsstrahlung or tabular absorption opacities. Equation of state tables from the Los Alamos Sesame Library were used for materials of interest.

27944 Conductively cooled laser diode array pumped laser. Conaway, L.K. (to Secretary of the Air Force, Washington, DC). US Patent 4,719,631. 12 Jan 1986. Filed date 10 Jan 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A conductively cooled laser diode array is described comprising: (a) flat ceramic plates made substantially from heat conducting beryllium oxide; (b) electrically conductive material applied to a portion of the plates; (c) laser diodes affixed directly to the plates and electrically connected to the electrically conductive material on the plates; and (d) clamping means for assembling a stack of the plates into the conductively cooled laser diode array wherein the plates are stacked immediately adjacent to each other and form a heat path for dissipating heat produced by the laser diodes.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 27456, 27590, 27599, 27679, 27895, 27923

27945 (BAE-TP—8430) Orbital Replaceable Unit (ORU)/cold plate thermal interface study. Volume 1: Executive summary. Final report. Nikanpour, D. (British Aerospace Public Ltd. Co., Stevenage). Apr 1987. 27p. (ESA-CR(P)—2456; ETN—88-91151). NTIS, PC A03/MF A01.

A pressurized dry heat pipe connector concept and low melting point alloy interface material were compared for thermal control of high power orbit replaceable payloads. The use of the pressurized contact concept for improving the efficiency of a dry thermal interface has considerable advantages over other methods of mechanical clamping, particularly where large contact areas are required for the transfer of high heat fluxes. Moderate values for the joint conductance, up to 1000 W/sq m K are attainable. A cylindrical or conically shaped contact surface where connector heat pipes are pressed together in a radial direction can transfer high heat fluxes in relatively small sized thermal connectors. It also enables passive back-up concepts such as the low melting point alloy interface material to be integrated in the connector design. Tests show it is possible to achieve values of 7000 W/sq m K with the proposed thermal interface concept.

27946 (FRCEA-TH—58) Study of thermic numeric modelization for an outside reactor nuclear assembly. Yala, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France)). Dec 1987. 126p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753182/JAW.

A spent fuel assembly emits a residual power which is principally the result of the radioactive decay of fission products. It is necessary to know the evolution of the temperature in the spent fuel in order to prevent for an excessive overheating in the fuel during all the operations after unloading. To response at this objective we have realized a numeric program modelling the thermic of spent fuel assembly, outside nuclear reactor, in gaseous environment. The originality of this computer code COBRA is to purpose a simplified formulation for the calcul of exchanges by thermal radiation.

27947 (INIS-BR—1040) Study of pressure drop in a mock-up of fuel element cluster. Barros Filho, J.A. (Minas Gerais Univ., Belo Horizonte (Brazil). Curso de Pos-graduacao em Ciencias e Tecnicas Nucleares). 1987. 191p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702304/JAW.

Results of single-phase tests performed in a 3 x 3 rod bundle arranged in square array are presented and analysed. The tests were performed in adiabatic conditions and with heat transfer, covering the following range of parameters: Reynolds no.: 1,5 to 20 x 10/sup 4/; inlet temperature [/sup 0/C]: 30 to 150; pressure [bar]: 1 to 15; heat flux (kW/cm/sup 2/]: 0 to 1000. Correlations were determined for the friction factor, isothermal and under conditions of heat transfer, spacer grids pressure drop coefficient and average heat transfer coefficient. The experimental data were compared with published data obtained by other researchers and with some theoretical models selected in the literature.

27948 (INIS-BR—1054) Stream function-vorticity finite elements and the resolution of the Navier-Stokes equations. Almeida, R.C.C. de. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). Jul 1987. 121p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702318/JAW.

A stream function-vorticity finite element formulation for the solution of the Navier-Stokes equations is proposed. The present work shows a procedure to solve the problem posed by the no-slip conditions on solid frontiers which can also be applied to flow problems in a multi-connected domain. Moreover, a methodology to solve the pressure is developed using the stream function-vorticity approximate solution. Numerical experiments were conducted for some steady and unsteady problems and the performance of the proposed methods is discussed.

27949 (KFK—4323) Velocity and turbulence distributions in wall subchannels of a rod bundle in three axial planes downstream of a spacer grid. Rehme, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Dec 1987. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753272/JAW.

Measurements of the mean velocity, of the wall shear stresses, and of the turbulence have been performed in two wall subchannels (P/D = 1.223; W/D = 1.183) of a rod bundle of four

parallel rods arranged in a rectangular channel for three axial planes. A spacer grid of the SNR-type was inserted in the rod bundle at ratios of distance between the spacer grid and the measuring plane and the hydraulic diameter of L/D/sub h/ = 8.44, 4.61 and 1.93, respectively. The Reynolds number of this investigation was Re = 1.56x10/sup 5/. The results show that the distributions of the velocity and of the turbulence are strongly affected by the spacer grid. The effects of the spacer grid increase with decreasing distance from the spacer grid.

27950 (N—88-15794) Optical measurement systems. Lesco, D.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1987. vp. (NASA-CP—10003-SESS-4; E—3798-SESS-4; NAS—1.55:10003-SESS-4). NTIS, PC A05/MF A01.

Some of the areas of research conducted at Lewis on optical measurement techniques are described. Two laser anemometer systems developed at Lewis are used to illustrate the special instrumentation needs encountered in aeropropulsion research. Velocity measurements to be made through small viewing ports, close to surfaces within the propulsion system components, and in turbulent or highly-accelerating flows are some of the significant challenges. The application to research facilities of two advanced optical systems, the rainbow schlieren and the combustor viewing system, is presented. The calibration and verification of commercial optical measuring systems, such as droplet sizing systems, are also discussed. Calibration techniques capable of simulating moving droplets for flight-type sizing systems are being developed at Lewis. The presentation concludes with a brief look at the forces driving future research on optical instrumentation.

27951 (NUCLEBRAS-CDTN—590) Study of the pressure drop in a rob bundle arranged in square array. Barros Filho, J.A. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1987. 192p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702475/JAW.

Results of single-phase tests performed in a 3 x 3 rod bundle arranged in square array are presented and analysed. The tests were performed in adiabatic conditions and with heat transfer, covering the following range of parameters: Reynolds no.: 1,5 to 20 x 10/sup 4/; inlet temperature [/sup 0/C]: 30 to 150; pressure [bar]: 1 to 15; heat flux [kW/cm/sup 2/]: 0 to 1000. Correlations were determined for the friction factor, isothermal under conditions of heat transfer, spacer grids pressure drop coefficient and average heat transfer coefficient. The experimental data were compared with published data obtained by other researchers and with some theoretical models selected in the literature. (Autor).

27952 (PB—88-148176/XAB) Finite-element analysis of multiphase immiscible flow through soils. Kuppusamy, T.; Sheng, J.; Parker, J.C.; Lenhard, R.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Water Resources Research, Vol. 23, No. 4, 625-631(Apr 1987).

A finite-element model is developed for multiphase flow through soil involving three immiscible fluids: namely, air, water, and a nonaqueous phase liquid (NAPL). A variational method is employed for the finite-element formulation corresponding to the coupled differential equations governing flow in a three-fluid phase porous-medium system with constant air phase pressure. Constitutive relationships for fluid conductivities and saturations as functions of fluid pressures, which are derived in a companion paper by J. C. Parker et al. (this issue) and which may be calibrated from two-phase laboratory measurements, are employed in the finite-element program. The solution procedure uses backward time integration with iteration by a modified Picard method to handle the nonlinear properties. Laboratory experiments involving water displacement from soil columns by p cymene (a benzene-derivative hydrocarbon) under constant pressure were simulated by the finite-element program to validate the numerical model and formulation for constitutive properties.

27953 (PB—88-860457/XAB) Ceramic heat exchangers. January 1970-March 1988 (Citations from the US Patent data base). Report for January 1970-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 63p. NTIS PC N01/MF N01.

Supersedes PB—87-853040.

This bibliography contains citations of selected patents concerning the utilization of ceramic materials in the manufacture of industrial heat exchangers that are resistant to corrosion, abrasion, and thermal stresses. The design and fabrication of rotary, recuperative, and regenerative heat exchangers are discussed. Ceramic heat exchangers employed in gas turbines and waste-heat-recovery equipment are described. (This updated bibliography contains 130 citations, 15 of which are new entries to the previous edition.)

27954 Spectral methods for the small disturbance equation of transonic flows. Fishelov, D. (Dept. of Mathematics, Univ. of California, Berkeley, CA 94720 (US)). *SIAM Journal on Scientific and Statistical Computing;* 9: No. 2, 232-251(Mar 1988).

Spectral methods for the small disturbance equation of transonic flows are developed. Two schemes are presented. One of the is spectral in chi and y of second order in tau. The other is spectral in chi and of second order in y and tau. A method for extracting a highly accurate solution for problems containing a discontinuity is presented. The solution is obtained by fitting the standard spectral approximation to a sum of a step function and a truncated Chebyshev series. An application to the Burgers equation and to the small disturbance equation is described.

27955 Heat transfer in condensation of lithium vapors. Oh, C.H.; Wadkins, R.P. (EG & G Idaho National Engineering Lab., Idaho Falls (USA)). pp 6 of Aerospace sciences meeting. Reno, NV; AIAA (1988). (AIAA-Paper—88-0355; CONF-880139—).

From 26. AIAA aerospace conference; Reno, NV, USA (10 Jan 1988).

This paper presents the results of an experimental investigation into lithium condensation. The objective of the investigation is to find the condensing side heat transfer coefficients of lithium on the vertical flow configuration and to explain the discrepancy between Nusselt's theory and experimental results. The heat fluxes in these experiments varied from about 13,000 W/sq m at 833 K to 130,000 W/sq m at 898 K, giving heat transfer coefficients of 4078 W/sq m K to 37,805 W/sq m K. These values appear 0.3 to 3 percent of those predicted by the Nusselt theory. Condensate film thickness was calculated by the Nusselt theory. Boiling and condensing of lithium at low, less than atmospheric pressure, appears to be an efficient energy transport mechanism that may find use in space applications or cooling of the first wall in fusion reactors. 19 references.

27956 Some perspectives on the modeling of plasma jets. Dilawari, A.H.; Szekely, J. (Massachusetts Institute of Technology, Cambridge (USA)). *Plasma Chemistry and Plasma Processing;* 7: No. 3, 317-339(Sep 1987). Contract FG02-85ER13331.

A mathematical representation is developed describing the temperature and the velocity profiles and mixing in a plasma jet discharging into ambient air. In the model, realistic allowance is made for turbulent behavior, the temperature-dependent property values, and also for the boundary conditions, including entrainment. The more precise definition of the boundary conditions, mixing, and entrainment are thought to be important novel features of this work. The theoretical predictions were found to be in good agreement with measurements reported by Vardelle regarding the behavior of a nitrogen plasma, but the agreement was less satisfactory for an argon plasma jet. Possible reasons for the discrepancy are discussed.

27957 Measurements of gas velocities and temperatures in a large open pool fire. Schneider, M.E.; Kent, L.A. (Thermal Test and Analysis Div., Sandia National Labs., Albuquerque, NM (USA)). pp 37-48 of Heat and mass transfer in fire. Kulkarni, A.K.; Jaluria, Y. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—). Contract AC04-76DP00789.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

There is an interest in determining the response and survivability of a variety of items subject to engulfment in a large fire which may occur in a transportation accident. In order to estimate this response, knowledge of the thermal and flow conditions prevailing in these pool fires is required. Few experiments have been performed with large (>3 meter diameter) fires. In particular, velocity measurements in the continuous flame region of low Froude number fires are very scarce. Scaling up the results of small pool fires is problematic due to the large number of relevant dimensionless variables to be matched. A total of — 48,500 liters of JP-4 fuel was burned in a 9x18 meter pool, producing peak temperatures in excess of 1230°C (2250°F), over much of the instrumented region of the flame. Temperatures were measured at 28 locations throughout the continuous flame region with 1.587 mm OD Inconel sheathed, ungrounded, type K thermocouples. Four 0.127 mm diameter bare wire thermocouples used to make high frequency response temperature measurements. Velocities were measured at four vertical stations near the centerline of the pool, with glass coated, velocity probes. Heat fluxes were estimated from measurements on and near vertically suspended mild steel plates. As is often the case in fires of this size, the effects of mild ambient winds on the measurements were pronounced. Attempts have been made to mitigate these effects by the application of conditional sampling. Temperatures are compared with measurements made in other large aviation fuel fires. The measured velocities are slightly less than would be predicted from an empirical model that was developed from experimental results for methane diffusion flames that are orders of magnitude smaller.

27958 Anisotropic scattering in three dimensional differential approximation of radiation heat transfer. Condiff, D.W. (Reactor Analysis and Safety Div., Argonne National Lab., Argonne, IL (USA)). pp 19-28 of Fundamentals and applications of radiation heat transfer. Smith, A.M.; Smith, T.F. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The differential approximation is extended to account for anisotropic scattering in invariant three dimensional form. A moment method using polyadic Legendre functions establishes that pressure cross sections should take precedence over extinction cross sections for treating radiation heat transfer in an absorbing, emitting, and scattering medium, and that use of these cross sections accounts for the extent of preferred forward or backwards scattering. The procedure and principle is extended to polyadic P-N approximations.

4205 Materials Testing

REFER ALSO TO CITATION(S) 27602, 27731, 28680

27959 (AD-A—188059/0/XAB) High-resolution prototype real-time radiography system. Final report, 20 July 1983-31 April 1986. Polichar, R.M. (Science Applications International Corp., San Diego, CA (USA)). Nov 1986. 189p. NTIS, PC A09/MF A01.

This report covers the evaluation of a number of advanced x ray converter screens. It concentrates in particular on screen types that are compatible with direct fiber-optic readout. The new converters included several types of scintillating fiber-optic screens, intagliated phosphor screens, and depositions of high-efficiency screens directly on fiber-optic couplers. The study covered the x ray potentials between 20 and 320 KV. The report also describes the use of these screens with a solid-state line scan sensor and the advantages that such a sensor has in high resolution real-time radiography. Illustrations are provided on applications of this new technology to inspection of aerospace, electronic and ordnance samples. A design for an advanced solid-state line scanner is presented and its performance parameters predicted.

27960 (FhG-IzfP—850117-TW) Software development for planary location of acoustic emission sources in the case of peak or threshold triggering. Final report. Waschkies, E. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren). 18 Apr 1985. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753233/JAW.

The concept of a six-channel, digital research away developed by the IzfP (Fraunhofer Inst. for Nondestructive Testing) is explained. The array works on the basis of independent input channels, and requires a more complicated structure of organisation of input and output data. The working principles of the data preparation programs required is described, and the advantages offered by this concept of independent channels are shown discussing the manifold possibilities of signal analysis that are possible with this system. The problems arising from planary location and threshold or peak triggering are explained by means of mathematical solutions. An assessment is presented of the maximum possible location errors, and the algorithms are described that are used for the planary 4- or 3-probe location.

27961 (INIS-mf—11155) Digital simulation of anodic stripping voltammetry from thin film electrodes. Magallanes, J.F. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Procesos Quimicos; La Plata Univ. Nacional (Argentina). Facultad de Ciencias Exactas). 1984. 97p. (In Spanish). NTIS (US Sales Only), PC A05/MF A01 - Comision Nacional de Energia Atomica, San Carlos de Bariloche (AR). Order Number DE88702335/JAW.

The anodic stripping voltammetry (ASV) is routinely applied to control of Cu(II) in heavy water in the primary cooling loop of the Nuclear Power Reactor. The anodic stripping voltammetry (ASV) is a very well-known technique in electroanalytical chemistry. However, due to the complexity of the phenomena, it is practised with the fundamentals of empiric considerations. A geometric model for the anodic stripping voltammetry (ASV) from thin film electrodes which can be calculated by explicit digital simulation method is proposed as a possibility of solving the electrochemically reversible, cuasi-reversible and irreversible reactions under linear potential scan and multiple potential scans. (Until now the analytical mathematical method was applied to reversible reactions). All the results are compared with analytical solutions and experimental results and it permits to conclude that the anodic stripping voltammetry (ASV) can be studied with the simplicity and potentialities of explicit digital simulation methods. (M.E.L.).

27962 The relative impacts of acidic deposition and air pollution on damages to materials. Lipfert, F.W. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY 11973 (USA)). pp 212-220 of Proceedings of the seventh world clean air congress. Eastwood, Australia; Clean Air Society of Australia and New Zealand (1986). (CONF-860803—).

From 7. world clean air congress and exhibition; Sydney, Australia (25 Aug 1986).

The use and derivations of damage functions to describe rates of damage to materials due to acidic deposition are discussed, with reference to zinc, copper, and calcium carbonate (both as calcareous stones and as an extender material in paints). The damaging agents considered are wet deposition of hydrogen ion and dry deposition of SO/sub 2/. The parameters of this problem are thus the H/sup +/ concentration in precipitation and the frequency of occurrence of wetted surfaces (dry deposition). It is shown that the most sensitive materials would require relatively large changes in SO/sub 2/ (presumably from local sources) in order to compensate for the effects of wet H/sup +/ deposition (presumably from more regionally distributed sources).

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 27917, 27925, 27927, 27938, 28094, 28260

27963 **(PB—88-167317/XAB) Multitier specification for NSEP (National Security/Emergency Preparedness) enhancement of fiber-optic long-distance telecommunication networks. Volume 1. The multitier specification - an executive summary. Technical Information Bulletin.** Peach, D.F. (Department of Commerce, Boulder, CO (USA). Inst. for Telecommunication Sciences). Dec 1987. 54p. (NTIA—87-226-VOL-1). NTIS, PC A04/MF A01.

See also Volume 2, PB—88-167325.

Fiber optic telecommunication systems are susceptible to both natural and man-made stress. National Security/Emergency Preparedness (NSEP) is a function of how durable these systems are in light of projected levels of stress. Emergency Preparedness in 1987 is not just a matter of--can they deliver food, water, energy and other essentials--but can they deliver the vital information necessary to maintain corporate function of our country. 'Communication stamina' is a function of 'probability of survival' when faced with stress. This report provides an overview of the enhancements to a fiber-optic communication system/installation that will increase durability. These enhancements are grouped, based on their value in protecting the system, such that a Multitier Specification is created that presents multiple levels of hardness. Mitigation of effects due to high-altitude electromagnetic pulse (HEMP) and gamma radiation, and protection from vandalism and weather events are discussed in the report. The report is presented in two volumes. Volume I presents the Multitier Specification in a format that is usable for management review. The attributes of specified physical parameters, and the levels of protection stated in Volume I, are discussed in more detail in Volume II.

27964 **(PB—88-167325/XAB) Multitier specification for NSEP (National Security/Emergency Preparedness) enhancement of fiber-optic long-distance telecommunication networks. Volume 2. Multitier specification background and technical support information. Technical information bulletin.** Peach, D.F. (Department of Commerce, Boulder, CO (USA). Inst. for Telecommunication Sciences). Dec 1987. 225p. (NTIA—87-226-VOL-2). NTIS, PC A10/MF A01.

See also Volume 1, PB—88-167317.

This report provides an overview of the enhancements to a fiber-optic communication system/installation that will increase durability. These enhancements are grouped, based on their value in protecting the system, such that a Multitier Specification is created that presents multiple levels of hardness. Mitigation of effects due to electromagnetic pulse (EMP) and gamma radiation, and protection from vandalism and weather events are discussed. The study concludes that the probability of survival can be significantly increased with expeditious use of design and installation enhancements. The report is presented in two volumes. Volume I presents the Multitier Specification in a format that is usable for management review. The attributes of specified physical parameters, and the levels of protection stated in Volume I, are discussed in more detail in Volume II.

27965 **(PB—88-858592/XAB) Connectors for fiber-optic optics. January 1974-February 1988 (citations from the NTIS data base). Report for January 1974-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 48p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the design, development, analysis, and evaluation of fiber-optic connectors. Both fiber-optics transmission-cable and line connectors are discussed. Various types of connectors are examined including hermaphroditic, hybrid, multiple, tactical, graded index, and mirrored. Patented fiber-optic devices with optical connectors are included. (Contains 94 citations fully indexed and including a title list.)

27966 **(PB—88-858600/XAB) Fiber-optic couplers. January 1973-February 1988 (citations from the NTIS data base). Report for January 1973-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 107p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the design, fabrication, analysis, performance evaluation, and applications of fiber-optic couplers. Topics include optical coupling for fiber-optic transmission lines, frequency and wavelength division multiplexing, multiwavelength coupler-decouplers, single mode and multimode couplers, and fiber-optic gyroscope applications. Various types of couplers are examined including waveguide, star, access, duplex, data bus, passive, tee, and holographic. Patented fiber-optic devices using couplers are included. Citations concerning fiber-optic connectors are excluded and examined in a separate bibliography. (Contains 218 citations fully indexed and including a title list.)

27967 **(PB—88-859012/XAB) Quantum-well structures and devices. November 1984-December 1985 (Citations from the Searchable Physics Information Notices data base). Report for November 1984-December 1985.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 180p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the theory, principles, and physics of quantum-well structures and devices. Growth, properties, characterizations, and performance of a variety of quantum wells are covered. Special attention is given to quantum size effects for quantum-well heterostructures and superlattices. (This updated bibliography contains 208 citations, none of which are new entries to the previous edition.)

27968 **(PB—88-859020/XAB) Quantum well structures and devices. January 1986-February 1988 (Citations from the Searchable Physics Information Notices data base). Report for January 1986-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 173p. NTIS PC N01/MF N01.

Supersedes PB—86-854148.

This bibliography contains citations concerning the theory, principles, and physics of quantum-well structures and devices. Growth, properties, characterizations, and performance of a variety of quantum wells are covered. Special attention is given to quantum size effects for quantum-well heterostructures and superlattices. (This updated bibliography contains 372 citations, all of which are new entries to the previous edition.)

27969 **Demonstration of an InAsSb strained-layer superlattice photodiode.** Kurtz, S.R.; Dawson, L.R.; Zipperian, T.E.; Lee, S.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **52**: No. 19, 1581-1583(9 May 1988). Contract AC04-76DP00789.

A photodiode consisting of a p-n junction embedded in an InAs/sub 0.09/Sb/sub 0.91//InSb strained-layer superlattice with equal 130-A-thick layers was grown using molecular beam epitaxy. This nonoptimized device exhibited photoresponse out to a wavelength of 8.7 μm at 77 K. The resistance and the minority-carrier diffusion length of the photodiode result in a detectivity (3 x 10^9 cm Hz^{1}/sup //^{3}/W) at 7 μm that is within one order of magnitude of the detectivity of the best HgCdTe detectors at that wavelength.

27970 **Effect of bias on the response of metal-oxide-semiconductor devices to low-energy x-ray and cobalt-60 irradiation.** Fleetwood, D.M.; Winokur, P.S.; Dozier, C.M.; Brown, D.B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **52**: No. 18, 1514-1516(2 May 1988). Contract AC04-76DP00789.

The response of metal-oxide-semiconductor (MOS) transistors and capacitors to high-energy Co-60 gamma and low-energy x-ray irradiation is evaluated as a function of gate bias during exposure. It is demonstrated that, in contrast to previous expectations, the relative response of MOS devices to Co-60 gamma and 10 keV x-ray irradiation cannot be explained simply in terms of electron-hole recombination and dose enhancement effects.

27971 **Analytical solutions for the three-dimensional side-fringing field of magnetic recording heads.** Mayergoyz, I.D.; Bloomberg, D.S. (Electrical Engineering Department and Institute for Advanced Computer Studies, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics;* **63**: No. 8, 3381-3383(15 Apr 1988).

Using conical coordinates, and in the limit of small gap length, the three-dimensional boundary value problem for the side-fringing field of beveled recording heads is reduced to two dimensions. This makes it possible to use analytic functions of a complex variable, and find simple expressions, in terms of elementary functions, for the scalar potential and three-dimensional magnetic fringing field. For a given bevel angle, the spectral response for side reading from in-plane and perpendicular magnetization depends on a single dimensionless parameter, and a quasi-exponential falloff of this response is calculated as a function of the bevel angle.

27972 **Apparatus for unilateral generation of a homogeneous magnetic field.** Fukushima, E.; Rath, A.R.; Roeder, S.B. (to Dept. of Energy, Washington, DC). US Patent 4,721,914. 26 Jan 1988. Filed date 1 May 1984. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes an apparatus for generating within a selected volume a magnetic field having a uniform strength to a selected tolerance, comprising: a first electromagnet coil having a first number of turns N/sub 1/ at a first radius R/sub 1/ with a center of the first coil spaced axially a first distance from the selected volume; a second electromagnet coil axially concentric with and parallel to the first coil and having a second number of turns N/sub 2/ at a second radius R/sub 2/ greater than R/sub 1/ and spaced unilateral of the volume with the first coil a second distance greater than the first distance from the selected volume. The first radius and first distance and the second radius and second distance is functionally related to enable the first and second electromagnet coils to produce first and second electromagnet coils to produce first and second magnetic fields, respectively, having substantially linear gradients within the selected volume. N/sub 1/ and N/sub 2/ are effective when energized with predetermined first and second currents, respectively, to produce equal and opposite gradients of the respective first and second magnetic fields in the unilateral volume and a net magnetic field having a strength within the selected volume effective for nuclear magnetic resonance determinations.

27973 **Multiple resonant railgun power supply.** Honig, E.M.; Nunnally, W.C. (to Dept. of Energy, Washington, DC). US Patent 4,718,322. 12 Jan 1988. Filed date 19 Jun 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A multiple repetitive railgun power supply for accelerating a projectile at predetermined intervals is described comprising: a serially connected paired parallel rails for guiding the projectile and having an inductive load impedance; powering means for powering the paired parallel rails, each pair of parallel rails therein powered by a single powering means, each powering means comprising; a storage capacitor for providing energy to propel the projectile along the pair of parallel rails the storage capacitor having a first end connected to one rail in the pair of parallel rails and a second end; a storage inductor for providing a circuit with the storage capacitor resonant at a frequency determined by the predetermined intervals for accelerating the projectiles; and a saturable magnetic switch having a low impedance saturated state relative to the inductive load impedance for maintaining energy flow in the resonant circuit formed by the storage capacitor and the storage inductor and having a high impedance unsaturated state relative to the inductive load impedance for transferring energy flow to the pair of parallel rails.

27974 **High resolution digital delay timer.** Martin, A.D. (to Dept. of Energy, Washington, DC). US Patent 4,719,375. 12 Jan 1988. Filed date 9 May 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A high resolution delay timer for generating an output pulse following a trigger pulse at a time delay interval preset with a resolution which is high relative to a low resolution available from supplied clock pulses is described comprising: first lumped constant delay means for inputting the trigger pulse and generating a first output signal at predetermined interpolation intervals corresponding to the high resolution; first latch means in series connection with the first lumped constant delay means for detecting edges of the supplied clock pulse and latching the first output signal in response to a first one of the edges after the trigger pulse to form first high resolution synchronizing delay data; input means for presetting a selected time delay interval with a first timing portion having a relatively low resolution and with a second timing portion having the high resolution; timer means in series with the input means and including counter means responsive to the first timing portion for relatively low resolution timing and second lumped constant delay means responsive to the second timing portion for timing at the high resolution wherein an internal pulse is generated at a delay temporally related to the preset time interval; circuit means in series with the timer means and receiving the internal pulse for initiating generation of second high resolution synchronizing delay data; and logic circuit means connected to receive the first and second synchronizing delay data in parallel for logically combining the first and second delay data and generating the output pulse synchronized with the trigger pulse and delayed by the preset high resolution time delay interval.

27975 **Piezoelectric shear wave resonator and method of making same.** Wang, J.S.; Lankin, K.M.; Landin, A.R. (to Dept. of Energy, Washington, DC). US Patent 4,719,383. 12 Jan 1988. Filed date 30 Sep 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A piezoelectric shear wave resonator having a predetermined temperature coefficient of resonance is described comprising: a composite comprising a first film of piezoelectric material having a 6 mm symmetry, the film having its C-axis substantially inclined at an acute angle with respect to the film normal, such that the shear wave coupling coefficient of the film significantly exceeds the longitudinal wave coupling coefficient of the film, and a second film of p/sup +/ silicon semiconductor material having a positive temperature coefficient of resonance, and a substrate supporting the composite at its periphery, the ratio of thickness of the semiconductor film to the piezoelectric film determining the temperature coefficient of resonance.

27976 **Stabilized chromium oxide film.** Garwin, E.L.; Nyaiesh, A.R. (to Dept. of Energy, Washington, DC). US Patent 4,719,436. 12 Jan 1988. Filed date 4 Aug 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a coated ceramic RF window and metal sleeve of a klystron comprising a stabilized chromium oxide film less than 200 angstroms thick deposited on a ceramic RF window and metal sleeve.

27977 **Repetitive resonant railgun power supply.** Honig, E.M.; Nunnally, W.C. (to Dept. of Energy, Washington, DC). US Patent 4,718,321. 12 Jan 1988. Filed date 19 Jun 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A repetitive railgun power supply for accelerating a projectile at predetermined intervals is described comprising: a pair of parallel rails for guiding the projectile and having an inductive load impedance; a storage capacitor for providing energy to propel the projectile along the pair of parallel rails, the storage capacitor having a first end connected to one rail in the pair of parallel rails and a second end; a storage inductor for providing a circuit with the storage capacitor resonant at a frequency determined by the predetermined intervals for accelerating the projectiles, the storage inductor having a first end connected to the other rail in the pair of parallel rails and a second end connected to the first end of the storage capacitor; and a saturable magnetic switch having a low impedance saturated state relative to the inductive load impedance for maintaining energy flow in the resonant circuit formed by the storage capacitor and the storage inductor and having a high impedance unsaturated state relative to the inductive load impedance for transferring energy flow to the pair of parallel rails. The magnetic switch has a first end connected to the first end of the storage inductor and a second end connected to the second end of the storage capacitor and has a volt-second capacity effective to maintain the high impedance state during the accelerating projectile and to switch to the low impedance state when an arc is formed between the rails as the projectile exits the rails.

4209 Waste Processing Plants And Equipment

27978 (PB—88-160528/XAB) Illinois recycled materials: market directory. (Illinois Dept. of Energy and Natural Resources, Springfield (USA). Office of Solid Waste and Renewable Resources). Dec 1987. 42p. (IL/ENR/RR—87/01). NTIS, PC A03/MF A01.

This market directory serves as a guide for recyclers desiring a comprehensive list of companies purchasing large volumes of residential and commercial post-consumer recyclables. Throughout the directory, recyclers are reminded to check with buyers regarding current-delivery schedules, requirements for material preparation and shipping, and to determine if buyers are actually purchasing the type of materials that you have to sell. In summary, this is a detailed guide to who is buying what and how they want it processed. But since market conditions and buying policies change, recyclers are cautioned to always contact buyers before shipping. The directory provides data on end manufacturers, major material processors, and brokers. It does not include a listing of collection centers for consumers to take recyclables nor does it include buyers of scrap iron and steel. That information is provided in the Directory of Illinois Recycling Centers, available from the Department of Energy and Natural Resources (ENR). Information was obtained primarily through telephone contacts with individual buyers.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 27950

27979 (N—88-15800) Aircraft engine hot section technology: an overview of the HOST Project. Sokolowski, D.E.; Hirschberg, M.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1987. vp. (NASA-CP—10003-SESS-5; E—3798-SESS-5; NAS—1.55:10003-SESS-5). NTIS, PC A08/MF A01.

NASA sponsored the Turbine Engine Hot Section Technology (HOST) Project to address the need for improved durability in advanced aircraft engine combustors and turbines. Analytical and experimental activities aimed at more accurate prediction of the aerothermal environment, the thermomechanical loads, the material behavior and structural responses to loads, and life predictions for cyclic high-temperature operation were underway for the last 7 years. The project has involved representatives from six engineering disciplines who are spread across three work sectors (industry, academia, and NASA). The HOST Project not only initiated and sponsored 70 major activities, but was also the keystone in joining the multiple disciplines and work sectors to focus on critical research needs. A broad overview of the project is given along with initial indications of the project's impact.

27980 (PB—88-860648/XAB) Catalytic cracking, June 1970-November 1985 (Citations from the Engineering Index data base). Report for June 1970-November 1985. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 232p. NTIS PC N01/MF N01.

This bibliography contains citations concerning applications of catalytic-cracking processes in fluidized-bed systems, moving beds, refineries, vacuum distillations, and reformers. Design aspects, modeling, control systems, and operating procedures are also discussed. (This updated bibliography contains 319 citations, none of which are new entries to the previous edition.)

27981 (PB—88-860655/XAB) Catalytic cracking, December 1985-March 1988 (Citations from the Engineering Index data base). Report for December 1985-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 42p. NTIS PC N01/MF N01.

Supersedes PB—85-871846.

This bibliography contains citations concerning applications of catalytic-cracking processes in fluidized-bed systems, moving beds, refineries, vacuum distillations, and reformers. Design aspects, modeling, control systems, and operating procedures are also discussed. (This updated bibliography contains 80 citations, all of which are new entries to the previous edition.)

4220 Underground Engineering

27982 (IFP—33-595) Numerical analysis of the pressuremeter test by the finite element method. Application to cohesive soils. Zanier, F. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). Sep 1985. 217p. (In French). NTIS (US Sales Only), PC A10/MF A01;1. Order Number DE88752590/JAW.

Pressuremeter tests were empirical until its interpretation based on derivative of pressure curve. Test analysis gives a soil stress-strain relationship, with some hypothesis concerning probe geometry. Different laws can be used for soil simulation and in each case solutions vary. Influence of probe geometry is analysed from a parametric study using the finite element method. An elastic-perfectly plastic law is first used and then improved to take into account material hardening and to match cyclic loading. The main aim of the study is soil parameter determination. Numerical results are compared to experimental results of the self-boring pressure meter developed by the Institut Francais du Petrole.

27983 (PB—88-163100/XAB) Toxicity tests of ten drilling fluids measured by the Beckman Microtox method. Halmoe, G. (SINTEF, Trondheim (Norway)). 21 Feb 1985. 17p. (STF—21-A85027). NTIS, PC A03/MF A01.

The report describes the test procedures and the results of the toxicity testing of ten drilling fluids. It is one part of a joint report with SI. The total report includes the introduction and summary/joint discussion of the results.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 27982

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 27661, 28169, 28172, 28175

27984 (PB—88-171731/XAB) Electrostatic precipitator with new energization system. Fujishima, H.; Yagyu, T.; Tomimatsu, K.; Nakayama, Y.; Matsumoto, Y. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1987. 6p. NTIS, PC E05.

Text in Japanese; Included in Mitsubishi Juko Giho, Vol. 24, No. 6, 589-594(1987).

The performance of conventional EP (Electrostatic Precipitator) decreases when the dust resistivity becomes high due to the back corona phenomenon. MHI has developed a new type of EP, which maintains a higher performance for high-resistivity dust by suppressing the back corona. The principle of the new EP is basically to provide a high-pulse-peak voltage onto discharge electrodes of the pre-charged section, so as to charge the dust to an absolute maximum. The pulse voltage is provided by a directly coupled pulse generator, developed by MHI. MHI, has already installed 4 EPs with the pulse precharger, and performance improvement for high-resistivity dust was confirmed. Also, this large-capacity directly coupled pulse generator has been connected to a whole field of conventional-type EPs, and high-performance improvement was confirmed for high-resistivity dust.

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 28771

27985 (CERN—87-12) Report of the advisory panel on the prospects for e/sup +/e/sup -/ colliders in the TeV range. Johnson, K.; Amaldi, U.; Montague, B.W.; Schnell, W.; Meer, S. van der; Willis, W.; Lawson, J.D. (European Organization for Nuclear Research, Geneva (Switzerland); Science and Engineering Research Council, Chilton (UK). Rutherford Appleton Lab.). (European Organization for Nuclear Research, Geneva (Switzerland)). 28 May 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702226/JAW.

This is the concluding report of the Advisory Panel on the Prospects for e/sup +/e/sup -/ Colliders in the TeV range, a panel set up by the CERN Long-Range Planning Committee chaired by C. Rubbia. The report covers general considerations, particle sources and the final focus and interaction point, before looking at various possible acceleration methods in some detail - normal rf linacs, superconducting acceleration structures, structures excited by opto-electrical switches, wake-field acceleration, and plasma beat-wave acceleration. It is concluded that one approach to a TeV collider, based on a normal conducting linear accelerator at a frequency of approximately 30 GHz and with a gradient of about 100 MeV/m, seems to give promise of leading to a real project in three to five years if enough manpower and money were invested in research and development. In the scheme outlined in the report, the drive power is obtained from an auxiliary beam of a few GeV, which in turn is accelerated by superconducting cavities identical to the ones now under construction for LEP 200. The panel also proposes that sufficient effort be devoted to continuing the research on more exotic schemes of acceleration, which in the longer term may lead to much higher gradients. The report was originally issued as CLIC note 38, and a complete list of these internal reports is given as an appendix.

27986 (INIS-mf—11165) Annual report 1984. (Saskatchewan Univ., Saskatoon (Canada). Saskatchewan Accelerator Lab.). 1984. 90p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702345/JAW.

After receiving a grant of 5.8 million dollars for an energy compressor system, a pulse stretcher ring and a new magnetic spectrometer, the Saskatchewan Accelerator Laboratory devoted itself mainly to an upgrading program in 1984. This report describes the project as well as the physics carried out to maintain contact with experiments.

27987 (INIS-mf—11166) McMaster Accelerator Laboratory annual report, 1984. (McMaster Univ., Hamilton, Ontario (Canada). Tandem Accelerator Lab.). Nov 1984. 219p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702346/JAW.

Summaries of projects in progress constitute the major portion of this report. The tandem accelerator operated well during most of the year, with a number of heavy ion runs carried out at 10.44 MV. Tritium beams and polarized deuteron beams have been used extensively. Experiments using the multiplicity filter to study high spin states continue. An experiment was carried out relating to the search for a neutrino mass. Activity also continued in other areas of physics, engineering and medicine.

27988 (INIS-mf—11167) McMaster Accelerator Laboratory annual report, 1983. (McMaster Univ., Hamilton, Ontario (Canada). Tandem Accelerator Lab.). Nov 1983. 173p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702347/JAW.

The FN tandem accelerator has been upgraded with new spiral inclined field tubes and a pelletron charging system. Terminal voltages of 10 MV are obtained regularly, and improved injection optics allow higher transmission and increased beam currents. Much work has been done on tritium-induced reactions and with polarized deuteron beams. The study of nuclear phenomena at high spin and nuclear temperature using the multiplicity filter continues. Several experiments touch on other areas of physics, engineering, and medicine.

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 27535, 27536, 27537, 27850, 27851, 27852, 27853, 27854, 27855, 27878, 27879, 27883, 27884, 27885, 27886, 27888, 27889, 27890, 27891, 27892, 28056, 28057, 28079, 28080, 28081, 28082, 28083, 28084, 28085, 28086, 28087, 28308, 28649, 28650, 28651, 28684

27989 (AECL—8952) Operating experience with a 100% duty factor Alvarez accelerator. Ungrin, J.; Chidley, B.G.; Brown, J.C.; McMichael, G.E.; Clements, D.W.; Campbell, H.F. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1985. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702211/JAW.

A 100% duty factor Alvarez linear accelerator was built at the Chalk River Nuclear Laboratory as part of a program to develop accelerators suitable for electronuclear breeding. The 25 cell tank had a design frequency of 268.3 MHz and an output energy of 3 MeV. The high average power that occurs with 100% duty factor operation resulted in a number of rf heating problems not normally encountered in this type of accelerator. This report describes the accelerator and its associated systems and the solutions developed for the heating problems to allow operation at design fields and with beam currents up to 5 mA.

27990 (AECL—9004) Power handling capability of the THERAC structure. Labrie, J.-P. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702214/JAW.

The power handling capability and maximum duty factor of a 1.2 m long structure used in the THERAC accelerators are determined by computer modeling of the thermal stresses and by scaling the results of high power tests with a 2.45 GHz on-axis coupled structure. A higher power version of this structure that could be made with improved cooling is described.

27991 (BNL—40884) Experiments with high energy nuclear beams at Brookhaven: From AGS to RHIC [Relativistic Heavy Ion Collider]. Ludlam, T.W. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 14p. (CONF-8709252—1).

From International symposium on position detectors for high energy physics; Dubna, USSR (22 Sep 1987).

We have now seen the first results from experiments with high energy nuclear beams at Brookhaven and CERN. These experiments, which began about a year ago, use fixed targets at the AGS and SPS. These programs have begun with relatively light ions ($A \leq 32$ amu) to explore states of compressed nuclear matter in which high energy density is achieved in an environment of high baryon density at energies near the maximum for nuclear stopping. The widespread interest and excitement which these experiments have generated is due in large part to the fact that they are providing the first glimpse of what is expected to be an entire new regime of physical phenomena, and that these experiments will be followed in the near future by measurements with much higher beam masses and much higher collision energies. This is the mission of the Relativistic Heavy Ion Collider (RHIC) project now being prepared for construction at Brookhaven. In this presentation the author briefly describes the experiments which are now being carried out with ions accelerated in the AGS and the plans for heavier beams in the near future with the completion of the AGS Booster Synchrotron, which is now under construction. The author then discusses the status of the RHIC project.

27992 UCLA neutron therapy facility. Myers, L.T.; Miller, G.E.; Smathers, J.B. (Univ. of California, Los Angeles (USA)). pp 1082-1086 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The UCLA Neutron Therapy Facility (NTF) has recently been completed and is treating cancer patients with fast neutrons. The negative-ion, variable-frequency cyclotron for this facility is capable of accelerating 12-48 MeV protons and 7-22 MeV deuterons. Two variable energy ports and four fixed-energy ports are available on the cyclotron. A 46 MeV proton beam is used for the neutron therapy that is conducted in two separate treatment caves. A fixed, horizontal and an isocentric treatment assembly are available. The fixed energy beam ports are reserved for isotope production. This report describes the facility, the cyclotron and both neutron treatment assemblies, including the neutron collimator and the beryllium target. Neutron therapy and dosimetry are discussed in a companion paper.

27993 **Proton accelerator for medical applications.** Martin, R.L. (Argonne National Lab., IL (USA)). pp 1087-1091 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract W-31-109-ENG-38.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The conceptual design of a proton synchrotron for radiation treatment of cancer in a hospital is described. The proton energy would be variable on a pulse-pulse basis up to 250 MeV with a maximum accelerated current of 60 nA average at a 5 Hz repetition rate. The ring would consist of a number of small straight magnets for ease of construction and flexibility of arrangement of dipoles, quadrupoles, and drift spaces. The ring would be 23 ft in diameter. The same magnets (2 times the number) could also be arranged in a ring of twice the diameter. The synchrotron would then accelerate helium ions to 250 MeV/μ, suitable for the full range of radiation treatment. A major feature of this larger synchrotron, which is the one described below, is the ability to accelerate negative hydrogen ions to 250 MeV (with lower peak magnetic fields to avoid magnetic stripping of the ions) and utilize charge exchange extraction. The latter technique appears to be most promising for satisfying the requirements for dynamic raster scanning of narrow proton beams.

27994 **Design of a hospital-based accelerator for proton radiation therapy: scaling rules.** Gottschalk, B. (Harvard Cyclotron Lab., Cambridge, MA (USA)). pp 1092-1095 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An accelerator for proton-beam radiotherapy should have a maximum energy of 250 MeV and an average current of about 20 nA. The best choice appears to be a small fairly rapid-cycling synchrotron using room-temperature magnets. In designing such a machine one can focus attention on the repetition rate, which drives many of the other choices. Here we examine the consequences of repetition rate and aperture on injection energy, injector current, rf power and magnet power.

27995 **Review of the improvements in the quality and applications of photon beams from linear accelerators in radiation therapy and a projection of future trends.** Biggs, P.J. (Massachusetts General Hospital, Boston (USA)). pp 1096-1099 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Since the introduction of linear accelerators to radiation therapy in the 1950s, there have been considerable changes in their design and the quality of the beams they produce, resulting in a general reduction in morbidity and improvement in survival rates. Such changes include the development of isocentric machines, increasingly energetic, beams with suitable choice of target and flattening filter material to optimize % depth dose and reduce neutron background, dual photon energy machines and the development of independently adjustable jaws and dynamic wedges to permit more sophisticated treatments. Currently, the trend is towards the implementation of dynamic radiotherapy using multileaf collimators for field shaping.

27996 **Modification of a CP-42 cyclotron to meet clinical needs.** Zermeno, A.; Cowart, R.; Otte, V.; Horton, J. (Univ. of Texas System Cancer Center, Houston (USA)). pp 1100-1105 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The reliability of the prototype CP-42 cyclotron was seriously degraded by Dee insulator failures. The failures were caused by excessive rf power levels required to overcome phase losses introduced by spurious oscillations within the free-running power oscillator. The improvement of beam transport to the insocentric gantry required addition of an X-Y steering magnet and replacement of a small quadrupole singlet with a larger quadrupole doublet. The installation of three beam profile scanners greatly simplified daily tuning procedures.

27997 **RF linacs for SDI.** Jameson, R.A. (Los Alamos National Lab., NM (USA)). pp 725-729 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Radio-frequency linear accelerators are key elements of Strategic Defense Initiative systems for producing neutral particle beams and for producing photon radiation using free-electron lasers. The R & D work for these applications will result in significant advances in all aspects of accelerators and supporting systems that will also benefit the application of these devices in other areas. Aspects of the current development work are outlined, and prospects for broader application are discussed.

27998 **Progress in accelerator technology for strategic defense.** Gullickson, R.L. (Strategic Defense Initiative Organization, Washington, DC (USA)). pp 730-735 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Progress in accelerator technology has made possible many applications in strategic defense. The feasibility of developing high brightness neutral particle beams has been demonstrated with a low energy pulsed test stand, and through individual component development. Free electron lasers (FELs) employing high peak power electron beams from induction linear accelerators are now a promising approach to ground based lasers. Advances in radio-frequency linear electron accelerators suggest applications for high average power free electron lasers for space or ground basing. The invention of laser guided electron beams using ion focusing has led to new recirculating accelerator concepts, beam transport with high efficiency, and novel applications for intense beams combining the best features of lasers and particle beams.

27999 **Accelerator research for heavy ion inertial fusion.** Godlove, T.F. (Dept. of Energy, Washington, DC (USA)). pp 736-740 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

It is now one decade since serious consideration was first given to the use of heavy ion accelerators for inertial confinement fusion. After an initial period of wide-ranging studies, the US program settled on an induction linac method proposed by Lawrence Berkeley Laboratory (LBL). The ion kinetic energy is modest (30-

100 MeV/amu, 5-10 GeV total) but intense beam currents of order 1 kA per beam in 10-30 beams are required on target in a short pulse of order 10-20 ns. In this review the conceptual designs are described, together with recent theory and experiments on high-current beam transport and use of multiple beams. Parallel efforts in West Germany, Japan and the Soviet Union are mentioned, and a two-year US study of heavy ion fusion electric power plants is summarized.

28000 Neutral beam injection on the tokamak fusion test reactor. Grisham, L.R.; Bell, M.G.; Blanchard, W.R.; Boody, F.P.; Bretz, N.; Budny, R.; Bush, C.E.; Cecchi, J.L.; Cohen, S.A.; Davis, S.L. (Princeton Univ., NJ (USA)). pp 741-745 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The neutral beam injection experiment on TFTR has now been underway for over two years, during which time we have injected as much as about 20 MW of beam power at energies up to 110 keV. We have obtained qualitative evidence of direct current drive by the injected beam ions. Recently we have produced plasmas in which the energy confinement time, β/sub p/, neutron emission, stored energy (both total and electron), and ion temperature exhibit a pronounced enhancement over previous behavior. Under these conditions we have obtained preliminary indications that significant bootstrap current is being driven. Operation will continue with new sources with which we should be able to increase the beam pulse length fourfold.

28001 ATLAS positive-ion injector project. Pardo, R.C.; Bollinger, L.M.; Shepard, K.W. (Argonne National Lab., IL (USA)). pp 746-751 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract W-31-109-ENG-38.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The goal of the Argonne Positive Ion Injector project is to replace the ATLAS tandem injector with a facility which will increase the beam currents presently available by a factor of 100 and to make beams of essentially all elements including uranium available at ATLAS. The beam quality expected from the facility will be at least as good as that of the tandem based ATLAS. The project combines two relatively new technologies - the electron cyclotron resonance ion source, which provides ions of high charge states at microampere currents, and rf superconductivity which has been shown to be capable of generating accelerating fields as high as 10 MV/m resulting in an essentially new method of acceleration for low-energy heavy ions.

28002 Superconducting cyclotrons at Michigan State University. Blosser, J.G. (National Superconducting Cyclotron Lab., East Lansing, MI (USA)). pp 752-756 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

This paper describes the status of the three superconducting cyclotrons which are in operation or under construction at the National Superconducting Cyclotron Laboratory. The oldest of these, the K500, has been in operation since September 1982 supporting a national user program in heavy ion nuclear physics. A second large research cyclotron, the K800, is now nearing completion. This cyclotron will accelerate lighter heavy ions to 200 MeV/nuc and heavier particles up to energies given by 1200 Q^2/A MeV/nucleon. The magnet for this cyclotron came into operation in May 1984 and has performed smoothly and reliably in three extended operating periods. At present, K800 construction activity centers on fabrication and installation of the rf system, the extraction system, and the ECR injection line. The third NSCL superconducting cyclotron is a smaller 50 MeV deuteron cyclotron to be used for neutron therapy in the radiation oncology center of a major Detroit hospital (Harper Hospital). Design features of this small, application oriented, cyclotron are described in some detail.

28003 Florida State University superconducting heavy ion linear accelerator - recent progress. Fox, J.D.; Frawley, A.D.; Myers, E.G.; Wright, M.L.; Chapman, K.R.; Smith, D.; Allen, P.; LaSalle, R.A. (Florida State Univ., Tallahassee (USA)). pp 757-758 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The superconducting heavy ion linear accelerator being constructed at Florida State University is reviewed. Recent progress with the partially completed system is discussed. Other equipment additions to the laboratory are described.

28004 Cluster ion acceleration with the radiofrequency quadrupole. Moser, H.O.; Schempp, A. (Institut fuer Kernverfahrenstechnik, Karlsruhe (Germany, F.R.)). pp 759-762 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

In order to increase the kinetic energy of accelerated cluster ions into the range beyond 1 MeV, to widen the atomic flux density limit imposed by intra-beam collision processes, and to reduce complexity and costs compared with electrostatic acceleration, the use of a radiofrequency quadrupole (RFQ) accelerator is examined. Two cases are considered: firstly, the acceleration of cluster ions in the mass range between 1 and 100 u from 5 to 50 keV/u which is interesting for basic research, secondly, the acceleration of cluster ions in the mass range between 1 and 10^6 u from 5 meV to 1 eV/u which is interesting for several technology applications. On the basis of the state of the art, the respective RFQ structures turn out to be feasible.

28005 New 3 MV tandem pelletron system. Schroeder, J.B.; Howell, C.W.; Norton, G.A. (National Electrostatics Corp., Middleton, WI (USA)). pp 763-766 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Extensive testing has recently been completed on a new 3 MV tandem accelerator system. A wide range of ion beam species with masses ranging from that of protons through gold have been accelerated. Beam energies as high as 39 MeV have been observed. Low energy beam testing has been carried out at 600 keV with the same mass range. This 3 MV tandem is the Model 9SDH-2 which is an extension of the economical S-Series Pelletron Systems. The configurations which are being manufactured will be discussed along with details of actual performance.

28006 Medical application of ion implantation (ionguard/ sup TM/) for overall improvement of titanium alloys. Sioshansi, P. (Spire Corp., Bedford, MA (USA)). pp 767-770 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Ion implantation is an emerging technology that allows for selective modification of the surface properties of materials. Properties such as hardness, corrosion resistance, friction and others can be improved without adversely affecting the bulk properties of the material. This paper concentrates on the discussion of the overall improvement of orthopaedic implants by the ion implantation

(IONGUARD/sup TM/) process. The unique capabilities, outstanding features and overall potential of the technology are described. Based on the very impressive improvement in wear, corrosion and fatigue resistance, the ion implantation process is expected to become the technology of choice not only for surface treatment of titanium orthopaedic implants but also in other medical applications such as titanium surgical scissors or dental implants. The technology is also expected to have an increasing contribution in a great variety of other applications such as the aerospace field.

28007 Radio-frequency linear accelerators for commercial ion implanters. Glavish, H.F. (GMW Associates, Redwood City, CA (USA)). pp 771-775 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

There is now a demand for production-type ion implanters capable of delivering high beam currents at energies in the MeV range. Hitherto, this application has been fulfilled only with dc machines of somewhat limited beam current. A recently developed radio-frequency linear accelerator has produced much higher beam currents yet is just as flexible as a dc machine in the sense that within seconds it can be programmed to accelerate any particle in the range of boron to antimony, to any selected final energy. Included in this review is a discussion of the general principles of rf acceleration including factors which determine the accelerating voltage gradient, energy spread, space charge limits, radial focusing, and the flexibility derived from independent rf phase control of individual rf accelerating cells. Various structures such as the two gap resonator and the rf quadrupole are considered in relation to ion implantation applications.

28008 Design if accelerators for ion implantation. Pedersen, B.O. (Varian Associates, Gloucester, MA (USA)). pp 776-782 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Industrial ion implantation equipment is described and the various unique requirements for this equipment are discussed. Some design detail of contemporary ion implanters is presented and some remaining problems as well as present development trends are discussed.

28009 Multi-MeV accelerator system for ion implantation. DiBitonto, D.; Huson, F.R.; McIntyre, P.M.; Nassiri, A.; Raparia, D.; Swenson, C.A. (Texas A & M Univ., College Station (USA)). pp 783-786 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Ion implantation makes possible dramatic improvements in the surface properties of metals. For many applications the required penetration depth is several μm, corresponding to an ion beam energy of several MeV. This paper describes the design of a compact, efficient accelerator system for such applications. The system is based on a MEVVA ion source and a high gradient rf quadrupole design.

28010 High current multichannel (MEQALAC) system for ion implantation. Weis, T.; Klein, H.; Schempp, A.; Van Amersfoort, P.W.; Siebenlist, F.; Thomae, R.W. (Univ. of Frankfurt (Germany, F.R)). pp 787-790 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Due to the increasing interest in ion implantation into semiconductors and metals as well as in neutral particle heating and plasma diagnostics in fusion experiments, high current and high energy (MeV range) beams of light ions are required. In a collaboration between the FOM-Institute, Amsterdam and the Frankfurt University a Multiple Electrostatic Quadrupole Array Linear Accelerator (MEQALAC) has been developed, which is able to accelerate parallel beams. This radio frequency (rf) device is useful for exit energies up to several MeV without the presence of a MV dc-voltage. The parallel ion beams produced by a multiaperture ion source are transported via a low energy beam transport (LEBT) section to a modified interdigital-H-TE(111) resonator structure, where the simultaneous acceleration of the beams in a common rf-field takes place. The proof-of-principle MEQALAC at FOM operates at 40 MHz and accelerates four He^+ beams of 2.2 mA each up to 116 keV. The properties of this machine will be reported. In a second stage of this project a new system for the acceleration of ions (namely N^+) at various frequencies (19-25 MHz) to allow for a variation of output energy and ion species is being built. Only ~ 2 m in length, this kind of rf-device could immediately be used for surface treatment of metals against corrosion.

28011 Low energy ion implanter for negative and positive ions. Yang, F.; Liu, J. (Institute of Physics, Beijing (China)). pp 791-792 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

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A low energy ion implanter for the energy range 100 eV-60 keV has been designed, manufactured and tested in the ion beam laboratory of the Institute of Physics. The system consists of a 30 kV extraction system, an analyzing magnet, a deceleration or acceleration system of changeable voltage from 0 up to 30 kV, and electrostatic scanning system and a UHV target chamber. Three different ion sources can be used at the ion implanter: a Penning ion source, a hollow cathode ion source and a negative sputtering ion source. The system has been designed for ion beam materials modification, surface analysis and atomic-molecular physics research.

28012 Performance of the NEC production high energy implantation system. Norton, G.A.; Klody, G.M.; Loger, R.L. (National Electrostatics Corp., Middleton, WI (USA)). pp 793-796 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

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MeV ion implantation systems are now being used on a production basis, providing beam energies in the range from 200 keV to 4 MeV. Interest and demand for such systems has increased since the first system went on-line in May 1983. At present, eight systems have been sold with a maximum beam energy capability of 4 MeV for use in the production environment. Production machines are now available providing beam energies as high as 8 MeV. These systems are capable of providing a wide range of ion species without the use of toxic gases. Present beam current and beam species capabilities will be presented. In addition, we describe new techniques for measuring dose uniformity from MeV implants [W.A. Keenan, Prometrix Corp., 3255 Scott Blvd., Bldg. 2, Santa Clara, CA 95054-3077, USA] and present results of uniformity and particulate measurements. We describe MeV implanter developments, including a new wafer handler.

28013 Field uses of a portable 4/6 MeV electron linear accelerator. Schonberg, R.G. (Schonberg Radiation Corp., Santa Clara, CA (USA)). pp 797-800 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The portable electron linear accelerator which was developed on Electric Power Research Institute funds was targeted to provide an additional inspection tool for the nuclear power industry. The results have justified the expense in cost savings by reducing unnecessary repairs and in demonstrating integrity of some critical welds in pump bodies. The minac (miniature accelerator) has proven effective in cases where other inspection techniques have been ineffective, such as cast stainless steel pump bodies and overlay clad welds. Other applications, such as dynamic imaging of rocket motor test firings and field inspection of pressure vessels, will be reported. A description of the equipment, the method of field operation and the special safety problems related to a high intensity radiation source without containment will be discussed.

28014 **Concepts for high gradient, dielectric cavity, induction accelerators.** Eccleshall, D. (Army Ballistic Research Lab., Aberdeen Proving Ground, MD (USA)). pp 801-804 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Induction accelerator cavities comprising various arrangements of constant impedance transmission lines have been devised to provide a constant acceleration to a short pulsed beam of electrons. In most of the cavity concepts the lines are charged externally from a voltage source such as a Marx generator and switched internally; in others energy is fed from an external bipolar source. Several cavities based on the former concepts have now been fabricated and can be used to accelerate efficiently electron beams with pulse durations of 10-20 ns and currents of 10-100 kA. Acceleration gradients are, however, limited to a few MeV/m for efficient transfer of the energy from the cavity to the beam. Gradients an order of magnitude higher could be obtained by recirculating an undermatched beam several times through the cavities so that only a fraction of the cavity energy is transferred on each pass. Various ways of magnetically bending and confining the beam to achieve this recirculation have been proposed. An attractive alternative in terms of overall weight, however, is to exploit beam propagation in the ion focused regime. In this scheme the beam is captured by and follows an ion trail formed by ionizing a very low pressure gas with a laser or, for a curved path, with a low energy electron beam. Efforts to demonstrate this recirculating linear induction technology are underway, notably at Sandia National Laboratory.

28015 **Improving the current carrying capability of the modified betatron.** Kapentanakos, C.A.; Dialetis, D.; Marsh, S.J. (Naval Research Lab., Washington, DC (USA)). pp 805-809 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Stability analysis of the macroscopic beam orbits indicates that the current-carrying capability of the modified betatron is substantially improved by adding torsatron windings that carry modest current. An analytic expression has been derived that gives the maximum beam current in a modified betatron as a function of the current in the torsatron windings and other relevant parameters.

28016 **350 keV accelerator facility for the University of Petroleum and Minerals.** Al-Juwair, H.; Blume, G.; Jaarsma, R.J.; Meitzler, C.R.; Purser, K.H. (Univ. of Petroleum and Minerals, Dhahran (Saudi Arabia)). pp 810-812 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A 350 keV light ion accelerator system for use as a neutron generator has been constructed. The operation of the system features exceptional stability. The timing characteristic of the beam pulsing system shows a 0.5 ns pulse with 63 mA of peak current. The inclusion of a polarized ion source is discussed.

28017 **Construction of the Louvain-la-Neuve 30 MeV 500 μA H^- cyclotron.** Jongen, Y.; Bol, J.L.; Chevalier, A.; Lacroix, M.; Ryckewaert, G. (Centre de Recherches du Cyclotron, Louvain-la-Neuve (Belgium)). pp 813-816 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The prototype of a new design of a 30 MeV H^- cyclotron for isotope production is in construction in Louvain-la-Neuve (Belgium). The original magnet design combines the advantages of compact and separated sector cyclotrons and requires less than 7 kW of electrical power. The ions are produced in an external multicusp ion source biased at 30 kV, and injected axially. The two 30° dees, supported on half-wavelength vertical resonators are connected at the center. The rf frequency is 65 MHz, and the power for 50 kV dee voltage is 5 kW for one cavity. The cyclotron operation will be fully automatic, using a high-level programmable controller. The magnetic field shimming is completed. Vacuum and rf tests are underway. The first beams are expected at the end of 1986.

28018 **Two industrial linacs: CASSITRON and CIRCE II.** Sadat, T. (Thomson CGR MeV, Buc (France)). pp 817-819 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

It is well known that ionization can preserve food products but it cannot improve their quality. On the other hand, ionization is an oxidizing process. Carbon-hydrogen links (particularly the unsaturated ones) are broken and in the presence of oxygen, oxidation is more important. Oxidation can be avoided only with an accelerator. So, CGR MeV has conceived CASSITRON and CIRCE II for industrial purposes.

28019 **Microtron in x-ray lithography.** Mileikowsky, C. (Scanditronix AB, Uppsala (Sweden)). pp 820-825 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The race-track microtron can play two important roles in x-ray lithography: it can serve as a low energy injector (at 50-150 MeV) to compact synchrotron/storage rings which are either normal conducting or superconducting: or it can, in a superconducting version, serve as full energy injector (at e.g. 680 MeV) integrated with a surrounding superconducting storage ring, forming a compact synchrotron light source.

28020 **New developments in low energy electron beam technology.** Rodrigues, A.M. (RPC Industries, Hayward, CA (USA)). pp 858-862 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Electron beam radiation processes are the result of a transfer of energy from electrons as they penetrate matter. This energy transfer initiates free-radical polymerization of coatings, inks, adhesives, etc., causing them to cure (dry). Also, modification of the physical characteristics of products is possible, as in crosslinking applications. Electrons produced by thermionic or plasma emission are accelerated to energies of 100-300 kV and impinged upon the materials. The technology and the characteristics of the equipment are discussed with emphasis on wide lines and high power applications.

28021 **Brazing techniques for side-coupled electron accelerator structures.** Hansborough, L.D.; Clark, W.L.; DePaula, R.A.; Martinez, F.A.; Roybal, P.L.; Wilkerson, L.C.; Young, L.M. (Los Alamos National Lab., NM (USA)). pp 863-867 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The collaboration between the Los Alamos National Laboratory and the National Bureau of Standards (NBS), started in 1979, has led to the development of an advanced cw microtron accelerator design. The four 2380-MHz NBS accelerating structures, containing a total of 184 accelerating cavities, have been fabricated and delivered. New fabrication methods, coupled with refinements of hydrogen-furnace brazing techniques described in this paper, allow efficient production of side-coupled structures. Success with the NBS RTM led to Los Alamos efforts on similar 2450-MHz accelerators for the microtron accelerator operated by the Nuclear Physics Department of the University of Illinois. Two accelerators (each with 17 cavities) have been fabricated; in 1986, a 45-cavity accelerator is being fabricated by private industry with some assistance from Los Alamos. Further private industry experience and refinement of the described fabrication techniques may allow future accelerators of this types to be completely fabricated by private industry.

28022 **Three-dimensional finite element heat transfer and thermal stress analysis of rf structures.** Tran Ngoc, T.; Labrie, J.P.; Baset, S. (Chalk River Nuclear Labs., Ontario (Canada)). pp 880-883 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Thermal expansion and thermal stress induced strain cause the detuning and limit the power level of radiofrequency (rf) structures. Two-dimensional finite element modeling has been used to determine the operating power limits of coupled cavity systems, but for complex high power accelerator structures without axial symmetry, a three-dimensional analysis is necessary. This paper describes results of a three-dimensional finite element temperature and thermal stress analysis. The analysis was performed for a high power coupled cavity linac structure operating at 1350 MHz. The results of the analysis are used to determine changes in the structure rf parameters as a function of power level and cooling water velocity.

28023 **Scientific opportunities at the proposed 6-7 GeV advanced photon source.** Shenoy, G.K.; Viccaro, P.J. (Argonne National Lab., IL (USA)). pp 884-887 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract W-31-109-ENG-38.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The availability of synchrotron radiation from bending magnet sources has contributed in a major way to new research in physics, chemistry, biology, materials science, and technologies. The newly proposed 6-7 GeV Advanced Photon Source based on insertion device sources (undulators and wigglers) will enhance the research capability in all these areas many-fold and provide new opportunities in even wider ranges of scientific and technological research. The characteristics of the synchrotron radiation from the insertion devices on a 6-7 GeV Advanced Photon Source will be discussed, highlighting their high brilliance and low beam divergence. Some of the unique scientific opportunities provided by such an insertion-device-based x-ray source will be presented.

28024 **Development of a standard 2.5-MeV neutron source.** Duvall, K.C. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 893-896 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The use of radiation for industrial purposes requires that the radiation measurement be reliable and accurate. The reliability of measurement may be verified by comparison measurements in standard radiation field. Standard radiation sources produce stable, well-characterized reference radiation fields, which are determined with a high degree of accuracy. A 2.5-MeV neutron source produced with a low voltage ion generator and the D(d, n)^{3}He reaction, is being developed at the National Bureau of Standards (NBS) for use as a standard radiation source. The source emission rate is stable within a well-defined neutron beam and determined by time-correlated associated-particle (TCAP) measurement. The measurement accuracy is expected to be comparable to that obtained in thermal and 14-MeV reference neutron fields. A standard 2.5-MeV neutron reference field could provide a means of establishing the 2.5-MeV spot energy as an intermediate energy normalization point.

28025 **White neutron source from 1 to 400 MeV.** Wender, S.A.; Lisowski, P.W. (Los Alamos National Lab., NM (USA)). pp 897-900 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A new high-intensity white neutron source has recently been constructed at Los Alamos. Beams of neutrons with a continuous energy distribution up to several hundred MeV are produced by the spallation reaction using the 800-MeV pulsed proton beam from the Los Alamos Meson Physics Facility (LAMPF)linear accelerator. The neutron facility has been designed to make very efficient use of the LAMPF beam with several experiments being able to operate simultaneously. Typical running conditions involve approximately 50,000 bursts/s and proton beam currents of 2.5 μA. Experiments planned for this fall include gamma-ray production, neutron induced fission, and medium energy (n,p) and (p,n) studies.

28026 **Transition radiation diagnostics for intense charged particle beams.** Rule, D.W. (Naval Surface Weapons Center, Silver Spring, MD (USA)). pp 901-904 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An overview of recent experiments conducted in order to develop precision beam diagnostics based on optical transition radiation (OTR) will be given. The aim of this series of experiments is to develop techniques to measure time-resolved beam current profiles, beam energy, and beam emittance in regimes of beam energy and current where standard methods are not readily applicable. Time-integrated values of beam energy and emittance for rf linac beams with energies of 10-30 MeV have been measured by expoiting the dependence of the angular distribution of OTR on beam energy and beam divergence. Time-resolved current profiles have been measured for a 1 kA, 800 keV single pulse beam also. Another technique using an OTR interferometer, which allows energy measurements to 1% and which is suitable for beam emittances of the order of tenths of a mrad-cm will be described.

28027 Design for a high intensity slow positron facility using forward scattered radiation from an electron linear accelerator. Hulett, L.D. Jr.; Lewis, T.A.; Alsmiller, R.G. Jr.; Peelle, R.; Pendyala, S.; Dale, J.M.; Rosseel, T.M. (Oak Ridge National Lab., TN (USA)). pp 905-908 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A tungsten moderator will be placed behind the target of the Oak Ridge Electron Linear Accelerator (ORELA) to convert gamma radiation to slow positrons. These will be extracted and led through evacuated solenoids to an experiment room. A Penning trap will be used to extend the slow positron pulses to achieve duty factors of 10% or greater. The facility will be used for atomic and molecular physics studies, positron microscopy, and materials research. Operations will be inexpensive and will not interfere with the normal function of ORELA, the measurement of neutron cross sections by flight-time spectrometry.

28028 Erosion measurement techniques for plasma-driven railgun barrels. Jamison, K.A.; Niiler, A. (Army Ballistic Research Lab., Aberdeen, MD (USA)). pp 909-913 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Plasma-driven railguns are now in operation at several locations throughout the world. All share common problems in barrel erosion arising from the fact that the bore surface must contain a high temperature plasma armature which transmits the acceleration force to a projectile. The plasma temperature at the core of the armature is estimated to be 30,000 K or higher. Such conditions are erosive to most materials even when the exposure time is 100 μs or less. We have adapted two accelerator based techniques to aid in the study of this erosion. The first technique involves the collection and analysis of material ablated and left behind by the plasma. This analysis is based on the unfolding of the Rutherford backscattered (RBS) spectra of 1 MeV deuterons incident on residue collected from a railgun bore. The second technique is an erosion measurement involving thin layer activation (TLA) of surfaces. In the process, the copper rail surface is activated by 2.4 MeV protons creating a relatively thin (3 μm) layer sparsely seeded with a long lived zinc isotope. Monitoring the decay of the activated sample before and after a firing can detect surface wear of about 0.1 μm. Results from the RBS and TLA experiments on the BRL plasma driven railgun are described.

28029 Electromagnetic railgun diagnostics. Farris, L.K.; Carollo, S.F. (LTV Aerospace and Defense Co., Dallas, TX (USA)). pp 914-916 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

LTV Aerospace and Defense Company utilizes two electromagnetic railguns, 12.7 mm and 20 mm bore sizes, to study railgun performance, projectile motion and flight characteristics, and impact phenomenology. This paper describes hardware and techniques used in analyzing railgun performance, projectile characteristics, and impact characteristics.

28030 Microcomputer based control system for the TAMU K-500 cyclotron. Haenni, D.R. (Texas A & M Univ., College Station (USA)). pp 917-920 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A parallel processor control system is being implemented for the K-500 superconducting cyclotron at TAMU. It consists of 10 cost effective personal computers communicating via a local area network. The cyclotron hardware is interfaced to the control system through IEEE-696 (STD bus) I/O cards and a memory mapped, tristate parallel data bus. Most of the software is being written in FORTH. Specific programs for each processor are compiled using tabular information extracted from a database describing the controls and accelerator hardware interfaces. This approach provides considerable flexibility in adapting the software to changing hardware configurations while eliminating the usual computational bottlenecks associated with an on-line data base.

28031 Microwave Cherenkov radiation as a diffraction phenomenon. Maruyama, X.K.; Buskirk, F.R.; Neighbours, J.F. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 921-924 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Cherenkov radiation results when the velocity of a charge particle exceeds the phase velocity of light in a medium. The wave front moves in a direction given by the Cherenkov angle theta/sub c/ with respect to the direction of the moving charge. The appearance of the well defined Cherenkov cone is a consequence of the assumption of an interaction length which is infinite when compared to the wavelength of the radiation observed. When the interaction region of the charged particle with the medium is finite, the Cherenkov radiation pattern is modified by diffraction. This condition is readily attained for microwave wavelengths. Microwave Cherenkov radiation in air has been observed to exhibit this diffraction characteristics. Coherence of radiation emitted from all the electrons in a micropulse of an rf linac has also been observed. For electron bunches periodic in time with frequency ν_0, radiation is emitted at ν_0 and harmonics thereof, in contrast to the continuous frequency distribution observed for a single charge. These and additional consequences of a finite interaction length are discussed.

4302 Beam Dynamics, Field Calculations, And Ion Optics

28032 (AD-A—187700/0/XAB) High-current density, high-brightness electron beams from large-area lanthanum hexaboride cathodes. Memorandum report. Loschialpo, P.; Kapetanakos, C.A. (Naval Research Lab., Washington, DC (USA)). 13 Dec 1987. 33p. (NRL-MR—6119). NTIS, PC A03/MF A01.

Large (approx. 5 cm) diameter lanthanum hexaboride (LaB_6) cathodes operated at 10 kV produced 1-5 micro electron pulses with current density between 10 and 20 A/sq. cm. Normalized beam brightness was consistently measured. To obtain this high current density, the LaB_6 cathodes have been heated to temperatures between approx 1600 to 1800 C. Very uniform temperature profiles are obtained by applying a carefully tailored electron-bombardment heating power distribution. These measurements have been made between pressure .000001 to .00001 Torr, i.e., under much less-demanding vacuum conditions than that required by conventional dispenser-type cathodes.

28033 (JINR-R—9-86-648) Production and study of therapeutic proton beams from modernized phasotron at the Laboratory of Nuclear Problems JINR. Abazov, V.M.; Gustov, S.A.; Zorin, V.P.; Kutuzov, S.A.; Mirokhin, I.V.; Mitsyn, G.V.; Molokanov, A.G.; Savchenko, O.V.; Filimonov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 8p. (In Russian). (CONF-8610384—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702176/JAW.

From Working meeting on proton beam therapy; Leningrad, USSR (14 Oct 1986).

The first results on shaping and transport of therapeutic proton beams of the JINR phasotron are presented. To provide the

flat-topped depth-dose distributions with steep back slope, the method of shaping the beam with a necessary energy spectrum from a non-monoenergetic beam is used. Extension of the flat-top of the depth-dose distribution is 4.7 g/cm/sup 2/ for the 200 MeV beam energy. 4 refs.; 6 figs.

28034 Nonlinear counterstreaming-beam wakefield accelerator. Yan, Y.T. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* 31: No. 5, 960-963(May 1988). Contract W-7405-ENG-36.

Using a counterstreaming electron beam to support a nonlinear wakefield for particle acceleration is investigated theoretically. This scheme has the following advantages over the plasma wakefield accelerator (PWFA): (1) easier beam loading; (2) higher transformer ratio; and (3) easier beam-pulse shaping. Additionally, the achievable accelerating gradient (GeV/m) is as large as that which can be obtained with a PWFA. A numerical comparison between this scheme and the PWFA is given.

28035 Noninterceptive wideband pickups for measuring the properties of very low intensity beams. Ellison, T.J.P.; Fox, C.M.; Koch, S.W. (Indiana Univ. Cyclotron Facility, Bloomington (USA)). pp 873-876 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Nondestructive wideband rf beam diagnostics, designed for use in the IUCF Cooler storage ring, are being used in the cyclotron beam lines. Wall gap monitors monitor the beam microscopic time structure, macroscopic time structure, and phase with respect to the main synthesizer; electrostatic pickup electrodes monitor the beam position and intensity. The signal processing and rf-interference-elimination techniques which allow these monitors to operate with beam intensities as low as 10 nA are described. The performance limitations for rf pickups in low energy, low intensity accelerators, and possible methods for using the powerful synchronous detection techniques with nonbunched beams are discussed.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 27742, 27821, 27822, 27823, 27824, 27825, 27826, 27827, 27828, 27829, 27830, 27831, 27832, 27833, 27834, 27835, 27836, 27837, 27838, 27839, 27840, 27841, 27842, 27843, 27844, 27845, 27846, 27847, 27848, 27849, 28399, 28400, 28401, 28403, 28404, 28405, 28406, 28407, 28408, 28409, 28411, 28413, 28414, 28415, 28418, 28423, 28427, 28429, 28430, 28431, 28433, 28434, 28435, 28436, 28437, 28438, 28439, 28440, 28441, 28442, 28443, 28454, 28456, 28458, 28459, 28460, 28461, 28462, 28463, 28464, 28465, 28467, 28468, 28469, 28473, 28474, 28475, 28476, 28477, 28478, 28479, 28480, 28481, 28482, 28483, 28484, 28485, 28486, 28487, 28488, 28489, 28490, 28491, 28492, 28493, 28494, 28495, 28496, 28497, 28498, 28499, 28500, 28501, 28587, 28591, 28592, 28596, 28597, 28598, 28601, 28602, 28603, 28604, 28606, 28610, 28611, 28612, 28614, 28615, 28620, 28621, 28652, 28653, 28654, 28655, 28656, 28760

28036 (BNL—40878) Studies of a pulsed volume source of H/sup -/ ions. Prelec, K. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-880256—3).

From 3. European workshop production and applications of light negative ions; Amersfoort, Netherlands (17 Feb 1988).

As part of the improvement program at the BNL Alternating Gradient Synchrotron, a new RFQ preinjector and its beam line are in the process of being assembled. A volume source of H/sup -/ ions is being considered as a backup for the existing magnetron source. The main advantage of the former is a cesium-free operation, making it in principle simpler and more reliable;it is also possible that the beam brightness would be higher than in the case of surface-plasma type magnetron source. The design of the source calls for an H/sup -/ current of 50 mA in 1 ms pulses at a 5 Hz rate;the emittance (normalized) should be less than π mm mrad. The first model had a cylindrical form, with LaB/sub 6/ cathode. Studies were done with several line cusp, circular cusp, and checkerboard cusp magnet configurations. So far, the highest yields were obtained with circular cusps, although the line cusp performance was not much inferior. Up to 20 mA of H/sup -/ current has been achieved so far, corresponding to a current density in the extraction aperture of about 25 mA/cm/sup 2/. A new model of the source was subsequently designed and constructed;based on the results obtained with the first model, it is expected that the new source will deliver the beam as required by the new RFQ preinjector. 1 ref., 5 figs., 1 tab.

28037 (BONN-IR—87-33) Calculation and construction of a beam-transport system for polarized electrons. Marschke, G. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Sep 1987. 77p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753226/JAW.

In the framework of the ELSA-SAPHIR project a transfer channel between ELSA and the large-space detector SAPHIR was calculated and constructed. Existing optical elements were modified corresponding to their application and the missing racks constructed and ordered for fabrication. Furthermore the vacuum system was designed as the whole as well as in the single components. Starting from the architectonic conditions and the optics to be realized the coordinates of the elements were calculated as preconditions fo the geodetic measurements and calibrations. It was shown that both for a polarized and for an unpolarized electron beam an optic was realized corresponding to the requirements up to an energy of 3.5 GeV. Under the given conditions, the applied method of the rotation of the polarization vector, and the geometrical preconditions up to 3.0 GeV also an acceptable longitudinal polarization was reached. (orig./HSI).

28038 (BONN-IR—87-34) Influence of coupled synchrotron-betatron resonances on the extracted beam of the stretcher ring ELSA. Neckenig, M. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Sep 1987. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753227/JAW.

For the correction of the chromaticity for horizontal and vertical direction each four sextupoles are installed in ELSA. At a working point near 14/3 their influence on the quantity of the stable region of the transverse phase space is essentially smaller than that of the extraction sextupoles. On the other hand the latter lie at positions of low dispersion so that their influence on the chromaticity is negligible; therefore chromaticity correction and choice of the stable phase-space region are not strongly mutually dependent which will be of advance for the later operation. In extraction with corrected chromaticity the electrons are extracted only because of their different position in the transverse phase space which leads to a timely alteration of the eta coordinate and by this to a migration of the extracted beam. Consequences of this are the strongly against extraction without chromaticity correction increased emittance and the doubled momentum uncertainty of the beam. Of advance however is the high extraction efficiency of 80% and the small number of the electrons remaining in the ring (below 2%). (orig./HSI).

28039 (BONN-IR—87-35) Conception, construction, and test of ironless quadrupoles for the resonance extraction from ELSA. Ebeling, H. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Sep 1987. 70p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753228/JAW.

The extraction from the new stretcher ring ELSA of the Physical Institute of Bonn University results as resonance extraction of third-numbered working points. Because the main aim of the construction of ELSA is the assembly of an extracted beam with timely constant intensity, which corresponds to a touch ratio of 100% first the slope of the approach to the resonance must be optimized with high accuracy and second the working-point shift existing at the end of an extraction cycle must be removed before the beginning of a new injection in order to constrain not the touch ratio. The extraction quadrupoles developed for the working-point shift and presented in this thesis from which four are installed in the ELSA ring were especially because of the second topic designed as ironless magnets. Theoretical calculations showed that for a circular-cylindrical conductor arrangement already a concept with only one conductor per octant yields at the choice of the azimutal conductor width yields to 30/sup 0/ an excellent quadrupole field with only small contributions of higher multipoles. Although

the disturbing fields are larger than calculated the field quality is yet within the aperture used by the beam completely sufficient. Because of the small conductor number moreover the inductivity of the magnets is extremely small so that from the extraction quadrupoles and their power supplies a touch ratio of above 99% would be possible. As all ELSA components also the extraction quadrupoles are included in the computer concept of the ELSA control system and by this remotely operable - thereby especially during the machine operation the current slope at one extraction cycle and by this the precise slope of the approach to the resonance can be optimized. (orig./HSI).

28040 (INIS-mf—11679) Construction of a second post-accelerator section at the Garching Accelerator Laboratory and studies on further development of the linear accelerator conception. Ratzinger, U. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). 28 Jul 1986. 68p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753262/JAW.

The present thesis describes the construction of the Garching heavy ion post-accelerator 'SchweIN' by adding of a second accelerator tank. As at the first it deals with a high-frequency accelerator with an interdigital H structure, however it has the double resonance frequency of the first tank and by this a frequency range between 135 MHz and 185 MHz in dependence on the velocity profile of the drift-tube structure. A special particle dynamic was developed which permits the coupling of several tanks to long acceleration lines. Construction and layout of the '2f-SchweIN' as wall of a postswitched De/Re buncher are explained. The high operational frequency of both cavities leads to high effective shunt impedances; for instance in the 2f-SchweIN 160 MΩ/m for a mean particle velocity anti $\beta=0.1$. is reached. The 2f-SchweIN tank is 3 m long, 0.65 m high, and 0.45 m broad, the aperture extends to 20 mm. For an effective accelerating voltage of 5 MV and anti $\beta=0.1$ the RF power consumption lies at 50 kW. RF measurements and hitherto beam-time results with the extended system concerning beam optics, accelerating voltage, and transmission are described. Finally proposals for possible further development of this accelerator type concerning the RF supply and the change of the drift-tube configuration without opening of the tanks are briefly indicated. (orig./HSI).

28041 (INIS-SU—26) Qualitative characteristics of open waveguide resonator spectra. Rud', L.A.; Sirenko, Yu.K.; Shestopalov, V.P.; Yashina, N.P. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 43p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702387/JAW.

Analysis of elements (inhomogeneities) of the SHF channels is due to the solution of complex problems of mathematical physics. The paper deals with the results characterizing qualitatively the spectrum of open waveguide resonators. The features of analytical prolongation of diffraction problem resolvents into range of complex values of a frequency parameter have been studied as well as their distribution on the corresponding Riemann surface. The ranges in which the points of a spectrum can be involved are localized roughly, and the theorem of their existance has been proved. A basis for a numerical analysis of spectra and studying of resonance excitation processes both in the stationary (diffraction) and non-stationary regimes has been got. Preprint-316; 39 refs.; 4 figs.

28042 (INIS-SU—27) Experimental investigation of simplest inhomogeneities in cylindrical slit line. Kovalenko, A.G.; Shestopalov, V.P. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 35p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702388/JAW.

Cylindrical slit line is a perspective SHF transmission line. The results of experimental investigation of inhomogenities which can appear in connection of sections of cylindrical slit line, i.e. different discontinuities, fractures in all planes jumps of slit width, angle errors of connection, slit overlap and others are given. For all inhomogeneities under investigation approximation dependences are obtained describing maximum losses in the operating frequency band. It is shown that some inhomogeneities can find practical use in designing of the element base on the basis of cylindric slit line. Preprint-301; 18 refs.; 16 figs.

28043 (JINR—9-87-172) High-voltage pulse generator with modified double shaping line. Arkhipov, O.V.; Krasnykh, A.K.; Smirnova, Z.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702423/JAW.

Submitted to the orginizing comittee of the 10. All-union seminar on linear accelerators of charged particles, Khar'kov, Jul 1987.

The design and experimental results obtained when investigating the high-voltage pulse generator are described. The pulse shaping line of the generator is performed on the base of a modified double shaping line. In the beginning part of the generator the step-up pulsed transformer is used which provides the voltage pulse with 180-200 kV amplitude, 1 kA current and the front of 200 ns. The one part of pulse shaping line of generator is a coaxial line filled ferrite cores K 180x110x20 shortly connected on the end, another part is a common coaxial line. On the matched load 75 Ohm the pulse of 140-150 kV, front approximately 5 ns and flat of 10 ns are achieved. The generator is intended for production of high-current nanosecond electron-beams. 2 refs.; 2 figs.

28044 (JINR—9-87-281) Forming and studying of physico-dosimetric parameters of 100 MeV mean energy medical proton beam with a modified Bragg curve. Abazov, V.M.; Gustov, S.A.; Zorin, V.P.; Kutuzov, S.A.; Mirokhin, I.V.; Mitsyn, G.V.; Molokanov, A.G.; Savchenko, O.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702424/JAW.

The physical-dosimetric parameters of 100 MeV mean energy medical proton beam of the reconstructed JINR phasotron are presented. To provide the flat-topped depth-dose distributions with a steep back slope the method for extracting the beam with a necessary energy spectrum from a monoenergetic beam is used. Extension of the flat-top of the depth-dose distribution is 1.7 g/cm/sup 2/. Dose rate is sufficient for carrying out medical and biological investigations. 4 refs.; 4 figs.

28045 Design considerations for a combined synchrotron light source and heavy-ion storage ring atomic physics facility. Jones, K.W.; Johnson, B.M.; Meron, M.; Lee, Y.Y.; Thieberger, P.; Thomlinson, W.C. (Brookhaven National Lab., Upton, NY (USA)). pp 381-390 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC02-76CH00016.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An atomic physics facility (APF) based on the combination of photons produced by a synchrotron light source with heavy ions in a storage ring will open the way to the study of ionic states of almost all elements. The design considerations for such a facility are discussed in terms of the use of synchrotron radiation for photoexcitation and ionization experiments. Design considerations for an APF are given in terms of the accelerator facilities presently available at BNL which include the National Synchrotron Light Source and Tandem Van de Graaff Laboratory. The results show that the concept is valid and therefore that implementation would result in entirely new capabilities for the study of multiply-ionized atoms.

28046 Synchrotron light source experiments: bringing Aladdin on line. Rowe, E.M. (Univ. of Wisconsin, Madison (USA)). pp 414-416 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

At the beginning of 1985, Aladdin, the 1 GeV electron storage ring at the Synchrotron Radiation Center of the University of Wisconsin - Madison, could achieve, at best, 1.5 mA at 800 MeV. By the end of February, 1986, the achievable current at 800 MeV

had risen to 150 mA. The scientific and technical effort that led to this two order of magnitude increase in performance is described.

28047 **CEBAF: a microscope for nuclei.** Gross, F. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). pp 432-436 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84ER40150.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The newest major construction project planned by the Energy Research Office of the US Department of Energy is CEBAF, the 4 GeV continuous electron beam accelerator facility dedicated to basic nuclear physics research. The status of the project, its physics program, and present plans for the initial complement of experimental equipment are briefly reviewed.

28048 **Emittance studies of high intensity negative ion sources equipped with continuous surface cylindrical and spherical geometry tungsten ionizers.** Alton, G.D.; McConnell, J.W.; Tajima, S.; Nelson, G.J. (Oak Ridge National Lab., TN (USA)). pp 826-833 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A digitally controlled emittance measurement, data acquisition and processing system has been designed, implemented and used to determine emittances of negative ion beams extracted from high intensity negative ion source equipped with cylindrical and spherical geometry cesium surface ionizers. Comparative studies indicate that the emittances of ion beams extracted from the source equipped with a spherical geometry ionizer are lower by 13-21% than those extracted from the source equipped with a cylindrical geometry ionizer. This difference may be attributable to geometric factors rather than differences in the sizes of the emission areas at the points of negative ion generation. Studies reveal that the emittances of these sources are independent of ion mass for most of the materials investigated and independent of ion current over the range of ion currents used in these investigations (4-12 μA).

28049 **Optically pumped polarized H^- ion sources.** Anderson, L.W. (Univ. of Wisconsin, Madison (USA)). pp 834-837 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract FG02-86ER40266.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The state of the art of optically pumped polarized H^- ion sources is discussed. The H^- ion current and polarization of such sources can be increased provided that the optically pumped Na charge exchange target density and percentage polarization can be increased. Our research on wall surfaces with low collisional depolarization rates and on the effects of radiation trapping on the target polarization show promise for improved performance of optically-pumped, polarized H^- ion sources.

28050 **DC means of highly charged ions from the EBIS.** Becker, R.; Kleinod, M.; Klein, H. (Universitaet Frankfurt (Germany, F.R.)). pp 838-840 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The originally pulsed Electron Beam Ion Source (EBIS) can be made operating continuously with dc electron as well as ion beams. In order to reach the desired high degree of ionization through sequential electron impact, the extracting electric field inside the source must be minimized. The ion containment is then provided by the time of flight of the ions along the electron beams. The highest charge states, which can be produced in this operating regime, are determined by the thermal velocity of the atoms before ionization and the acceleration of the ions by the Coulomb wind originating from the dynamic friction of small angle Coulomb collisions, acting always in the same direction. This in turn results in a low ion current of excellent beam quality even at low extraction voltages. We were able to use a beam of $10^6\ s^{-1}$ of Ne^{9+} as well as 3000 s^{-1} of bare Ne nuclei with a normalized emittance of π x 1^{-10} m rad in a coincidence collision experiment.

28051 **Applications of the MEVVA high current metal ion source.** Brown, I.G. (Lawrence Berkeley Lab., CA (USA)). pp 841-844 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A new kind of ion source has been developed in which a MEtal Vapor Vacuum Arc (MEVVA) is used to produce the plasma from which the ion beam is extracted. The novel and exciting feature of this source is the very high metal ion beam current attainable. A total ion beam current of over 1 Ae has been extracted from the embodiment of the concept that we are presently using, and this is not a limit of the method. The source was developed to upgrade the uranium ion beam intensity of the Bevatron, LBL's heavy ion synchrotron, for basic nuclear physics research. Other important applications include its use within the Heavy Ion Fusion research effort; for ion implantation; and for other basic research uses. In this paper the source is described briefly, its performance outlined, and its potential and limitations for a variety of applications is discussed.

28052 **Status and future prospects for polarized heavy-ion sources.** Kemper, K.W.; Chapman, K.R.; Sanderson, D.P.; Schmidt, B.G.; Van Verst, S.P. (Florida State Univ., Tallahassee (USA)). pp 845-848 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A ground state atomic beam source for producing polarized ^{6}Li nuclei is described. Representative data which cross calibrates three existing sources for ^{6}Li/sup →/ + ^{12}C at 20 MeV are presented. Possible future systems for producing polarized heavy-ion beams are discussed.

28053 **Multiply-charged heavy ion beams from a dirty bottle ion source in a single-ended Van de Graaff.** Huddle, J.R. (North Carolina State Univ., Raleigh (USA)). pp 849-851 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

With only simple modifications, standard rf ion sources can be used in single-ended accelerators to produce useful currents of argon beams of charge up to +5. If the ion source bottle is dirty from previous use, multiply-charged ion beams of the contaminants are also observed in useful quantities with pure argon as the source gas, although they may interfere with control of the machine on the argon beams.

28054 **Use of molybdenum ion source electrodes at RTNS-II.** Massoletti, D.J.; Harter, G.A.; Heikkinen, D.W. (Lawrence Livermore National Lab., CA (USA)). pp 852-854 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract W-7405-ENG-48.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Results are reported for an ongoing effort to optimize D^+ beam production by the MATS-III ion source used at RTNS-II. The three seven-aperture electrodes, originally consisting of water-cooled copper, have now been tested using uncooled molybdenum and with water cooling on the second (decel) electrode only. Details of the change, the results of the testing, and the benefits in operation, performance and cost are given.

28055 **Oxide cathode lifetime improvements at RTNS-II.** Massoletti, D.J. (Lawrence Livermore National Lab., CA (USA)). pp 855-857 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract W-7405-ENG-48.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Results are reported for an ongoing effort to optimize D^+ beam production by the MATS-III ion source used at the RTNS-II. The oxide cathode assembly originally designed for lower power operation has been modified and redesigned for higher electron current yield, longer life and serviceability. A factor of 2.5 has been gained in cathode lifetime due to these changes. The details of the changes and results and benefits in operation and performance are given. In addition, the technique used for manufacture of the filament is described.

28056 **Preparation of thin films for use in generating neutral particle beams.** Aaron, W.S.; Zevenbergen, L.A.; Adair, H.L.; McCulla, W.H.; Nolan, T.A.; Hughes, M.R. (Oak Ridge National Lab., TN (USA)). pp 944-949 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Large-area, thin Al foils were fabricated for use in particle beam neutralization experiments. The foils were used for survivability and lifetime studies when exposed to a H^- beam of 50 MeV with a peak beam-current density of 15.3 mA/cm^2. A range of foil thicknesses from 5 to 20 $\mu g/cm^2$ were required to determine the optimum foil thickness for converting H^- to H^0. The technique and equipment used to fabricate thin Al foils up to 25 cm in diameter are described in detail. Foil characterization including thickness, uniformity, purity, and structure before bombardment with the 500-MeV H^- beam is presented. Preliminary results from the H^- beam bombardment including neutralization results and foil survivability are described.

28057 **Materials technology applied to nuclear accelerator targets.** Barthell, B.L. (Los Alamos National Lab., NM (USA)). pp 957-962 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Modification of the crystal structure of physical vapor deposited (PVD) thin films and foils by the introduction of various lamellar constituents makes possible the production of very strong, stress free, metallurgical structures. Foils < 100 nm thick supported by grids 95% transparent have been produced by this technology for use as neutralizers for a neutral particle beam accelerator. Free standing, shaped, 5 μm thick foils, sieves, and other unusual shapes were designed for electron strippers for LAMPF at Los Alamos. Unbacked cylindrical foils 0.2 μm thick were developed for use on particle beam accelerators at Sandia National Laboratory and The Air Force Weapons Laboratory Shiva Accelerator in Albuquerque. A method of producing an ultrahigh strength Ni/Co tritium chamber for the MIT Linear Accelerator by electrodeposition which produced a lamellar structure was developed. These and other material developments will be presented in detail.

4304 Storage Rings

REFER ALSO TO CITATION(S) 28045, 28078, 28395, 28396, 28398

28058 **Multiple coil pulsed NMR method for measuring the multipole moments of particle accelerator bending magnets.** Clark, W.G.; Hijmans, T.W.; Wong, W.H. (Physics Department and Solid State Science Center, University of California at Los Angeles, Los Angeles, California 90024). *Journal of Applied Physics;* 63: No. 8, 4185-4186(15 Apr 1988).

An important step in the development and manufacture of the bending magnets for the proposed superconducting supercollider particle accelerator is measurement of the multipole moments of the magnetic field. This paper describes a method for doing so that makes use of the simultaneous pulsed NMR signal from a large number of coils placed on the diameter of a circle. From the value of the magnetic field thereby measured on the boundary, the multipole moments are obtained. Details of the basic concepts of the method are presented, along with some results of an early test of it.

28059 **Resonance injection method for the compact superconducting SR-ring.** Takayama, T. (Sumitomo Heavy Industries, Ltd., Hiratsuka (Japan)). pp 420-424 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A new half integer resonance injection method is introduced for a superconducting SR-ring of 1 m orbit diameter, which is made of a weak focusing single-body magnet. The present method makes it possible to accept an electron beam energy as high as 150 MeV. The resonance condition is induced by a non-linear perturbing field, which is generated with an air-core magnet. The strength of the perturbing field is acceptable for the pulsed operation.

28060 **Compact superconducting SR ring for X-ray lithography.** Takahashi, N. (Sumitomo Heavy Industries, Ltd., Hiratsuka (Japan)). pp 425-428 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A compact synchrotron radiation ring based on a new injection method has been designed as a light source for x-ray lithography, and is now being constructed. This machine consisting of a superconducting weak-focusing single-body magnet is 3 in outer diameter and 2.2 m in height. The injection method uses half-integer resonance to inject the high-energy and high-intensity electron beams into this small ring of 1 m orbit diameter. The beam injected at 150 MeV is accelerated up to 650 MeV, while the magnetic field is excited from 1.0 to 4.3 T at a rate of 0.02 T/s. Betatron tunes are changed dynamically during this acceleration period. A small cavity of two $\lambda/4$ coaxial resonators supplies the acceleration voltage of 120 kV. A vacuum chamber of a hybrid structure contains a beam duct and cryopanels. The vacuum pressure of the duct is 6×10^{-10} Torr. The beam intensity is 300 mA and its lifetime is longer than a day.

28061 **Influence of strongly curved large-bore superconducting bending magnets on the optics of storage rings.** Moser, H.O.; Dragt, A.J. (Institut fuer Kernverfahrenstechnik, Karlsruhe (Germany, F.R.)). pp 877-879 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

At present, small storage rings featuring strongly curved large-bore superconducting bending magnets are being studied or

are under construction at several places in the world. As shown previously, the optics of small rings can be strongly influenced by nonlinear effects. In addition, it is expected that particle trajectories will be influenced more strongly by end fields in the case of large-bore superconducting bending magnets than in the case of small-aperture iron magnets. In order to account for these effects, a computer code has been written to produce the orbit transfer map through third order for bending magnets. This transfer map can then be used in the nonlinear optics and tracking code MARYLIE. The transfer map is computed for the case of an arbitrary magnetic field with mid-plane symmetry. The magnetic field data must be provided separately, e.g., by a magnetic field code, measurements, or by analytic formulae. These tools are applied to the proposed lithography storage ring at Karlsruhe. It is shown how the end fields affect tunes, chromaticities, and stability limits.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 27991, 28342

28062 (AD-A—188845/2/XAB) Analysis of estimated versus actual development costs for an electronics state-of-the-art (SOA) extension. Master's thesis. Berube, R.E. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1987. 65p. NTIS, PC A04/MF A01.

This thesis is a case study that compares actual costs to estimated costs for a state-of-the-art (SOA) extension. The Advanced Nuclear Gamma-Ray Spectrometer (ANGAS) program initiated by the Defense Advanced Research Project Office (DARPA) in conjunction with the Research and Development Division of Lockheed Missiles and Space Company (LMSC), Inc. is the subject of this case study. This thesis identifies: the original description of the technology extension; the methods used at Lockheed to develop SOA extension cost estimates; specific factors that helped and hindered accurate cost estimating, and significant variances in cost and technological progress.

28063 (BONN-HE—88-02) Monte Carlo simulation of transition radiation and δ electrons. Appuhn, R.D.; Lange, E.; Oedingen, R.; Paul, E. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Jan 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753222/JAW.

This paper employs Monte Carlo simulations of the performance of a transition radiation detector (TRD). The program has been written for the TRD in the ZEUS spectrometer, which separates electrons from hadrons in the momentum range between 1 GeV/c and 30 GeV/c. Both, total charge method and cluster counting method were simulated taking into account various experimental parameters. In particular, it was found that the cluster counting method relies on a quantitative understanding of the background originating from the production of δ-electrons by charged particles. The results of the Monte Carlo calculations are in agreement with experimental data obtained with prototypes within a systematic uncertainty of 20%. We applied our Monte Carlo program to studies in order to find an optimum layout for the TRD within available space in the ZEUS spectrometer. In this context, the performance of TRD layouts with different geometries and materials has been evaluated comprehensively. The geometry found by optimization promises an improvement on hadron suppression by a factor of about two for both methods compared with present results from test measurements. Applying algorithms for a detailed analysis of the energy and space distributions of the clusters in the TRD, hadrons in the momentum range from 1 to 30 GeV/c can be suppressed to a level of less than 2%. This method of cluster analysing improves the suppression of hadrons by a factor of about two compared to the total charge method.

28064 (BONN-IR—87-02) High-voltage and readout electronics of the central drift chamber of the SAPHIR detector. Haas, K.M. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Jan 1987. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753223/JAW.

For experiments at the new BONN accelerator facility ELSA an experimental setup called SAPHIR (Spectrometer Arrangement for Photon Induced Reactions) is being built. The central detector of SAPHIR is a drift chamber matching the magnet gap of 1 m/sup 3/. The subject of this paper is the high voltage supply including the control system and the readout of the chamber. The mechanical construction and the electronics are described. The time resolution of the readout chain has been studied and was found to be slightly better than 1 nsec in accordance to the specification for the TDCs. Furthermore first preliminary results from a check in the BONN electron test beam are presented.

28065 (EP—83-R-21) Correction of the gamma emission spectrum of a thulium-170 source for the response function of the detector. . Galinier, J.-L.; Kennedy, G. (Ecole Polytechnique, Montreal, Quebec (Canada). Inst. de Genie Nucleaire). Apr 1983. 47p. (In French). (IGN—515). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702233/JAW.

The determination of the gamma emission spectrum of a radioactive source is a relatively complex problem. A direct measurement using a spectrometer produces a distribution which is the product of the primary spectrum by the reponse function of the detector. The response function can be broken down into the efficiency curve of the detector, losses due to Compton diffusion, and gamma summing effects. In this study a Ge(Li) detector was used to count a Th-170 source. The source was either uncovered, screened by aluminum, or in a container with a lead collimator.

28066 (INIS-BR—1022) Double Compton effect: a new method of detection. Cafagne, A. (Pontificia Univ. Catolica de Sao Paulo (Brazil)). 1978. 99p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702287/JAW.

In this paper, a new method of observation of the double Compton effect is described. The proposed method is based on the use of a sum-coincidence circuit, whose resulting pulse is in a fast coincidence (zeta=1,7x10/sup -8/sec) with pulses (~=10-/sup 9/ sec) from both scintillation detectors used to measure the energy of the coincident scattered gamma-rays. By means of this procedure, the contribution of the pulses from the sum-coincidence circuit due to random gamma-rays is eliminated. The spectra were registered in an Ortec model 6240 Multi-channel analyser using a further coincidence circuit, eliminate non-coincident pulses. The gate is open by a rectangulasr pulse which lasts for 10n sec and an adjustable delayed pulse generator adjusts its time-position in order to be coincident with the top of the sum-coincidence pulses. The adjustable delayed pulse generator compensates also for the finite time of propagation of the pulses in the circuits. Through this experimental technique it was possible to measure simultaneously the energy of each coincident photon which allowed an excellent comparison due the agreement found between the obtained results and the theory of Mandl and Skyrme.

28067 (INIS-BR—1023) Alkaline glass as induced fission fragment detectors. Amorim, A.M.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1986. 211p. (In Portuguese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702288/JAW.

The slide glass, registered trade marks INLAB, INVICT and PERFECTA were compared. For the three kinds of glasses the following studies were done: chemical composition; general dissolution rate for hydrofluoric acid solutions of concentrations between 1 and 10M, at 30/sup 0/C and ultrasound shaking; relative efficiency for recording fission fragment tracks from /sup 252/Cf. The INLAB glass was selected due to the better quality of its surface after chemical etching. The HF concentration 2.5M was determined for chemical etching of INLAB glass, and the optimum etching time was chosen between 8 and 10 minutes. The thermal attenuation of latent tracks in the environmental temperature was observed for intervals uo to 31 days between the detector exposure to the fission fragment source and etching of tracks. Several methods were used for determining the detector parameters, such as: critical angle, angle of the cone and efficiency of etching. The effects of gamma irradiation from /sup 60/Co and reactor neutrons in material properties as track detector were studied. Attenuation of latent tracks and saturation of color centers were observed for doses over

100M Rad. Since this kind of material contains uranium as impurity, uniformely distributed, slide glass were calibrated to be applied as a monitor of thermal neutron flux in nuclear reactor.

28068 **(INIS-BR—1032) Construction of a radiometer for pyroelectric detector and presentation of a model for detector design.** Siqueira, C.A. de. (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica). 1987. 250p. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702296/JAW.

An expression has been developed for the pyroelectric voltage as a function of electric and thermal parameters of the detector. It has also been developed expressions for determination of unknown parameters from the experimentally obtained pyroelectric voltage curve as function of time and some other known information. It has also been shown figures of merit for characterization of the detectors, a study showing the detector performance dependence on each electric and thermal parameter and some illustrative experimental results. The radiometer designed and built for this work, is described.

28069 **(INIS-BR—1035) Gaussian shaping filter for nuclear spectrometry.** Menezes, A.S.C. de. (Paraiba Univ., Campina Grande (Brazil). Coordenacao de Pos-graduacao em Engenharia Eletrica). 1980. 82p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702299/JAW.

A theorical study of a gaussian shaping filter, using Pade approximation, for using in gamma spectroscopy is presented. This approximation has proved superior to the classical cascade RC integrators approximation in therms of signal-to-noise ratio and pulse simmetry. An experimental filter was designed, simulated in computer, constructed, and tested in the laboratory.

28070 **(INPE—4174) Determination of gaussian peaks in gamma spectra by iterative regression.** Nordemann, D.J.R. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). May 1987. 14p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702396/JAW.

The parameters of the peaks in gamma-ray spectra are determined by a simple iterative regression method. For each peak, the parameters are associated with a gaussian curve (3 parameters) located above a linear continuum (2 parameters). This method may produces the complete result of the calculation of statistical uncertainties and an accuracy higher than others methods.

28071 **(JINR—13-87-419) Fast-response track processor.** Gus'kov, B.N.; Ivanchenko, I.M.; Kalinnikov, V.A.; Kirillov, D.A.; Krastev, V.R.; Pal'chik, V.V.; Chudakov, E.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Moskovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702425/JAW.

The research results of special trigger processor are presented. The processor is intended for event selection at the BIS-2 spectrometer experiments. The processor reconstructs the vertical projection of charged particle tracks and determines track number for each event. The solution time is 300 ns. The effect/background rate if increases by 1.3 - 1.8 times as a function of processor solution mode. 5 refs.; 5 figs.; 2 tabs.

28072 **(JINR—13-87-625) 128-channel logarithmic ADC for X-ray computerized tomograph.** Mitsyn, G.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702427/JAW.

The 128-channel 12-bit logarithmic analog-to-digital converter (ADC) which is indended for operation as a part of computerized X-ray tomographic has been developed. ADC consists of 5 CAMAC blocks (4 blocks of double width, 1 block of triple width). Signals from preamplifiers of detecting system pass to the circuit input. Digital code proportional to the logarithm of input signal amplitude passes to the HP-21MX computer. The main parameters to the ACD are as follows: dynamic range of input signals is from 5 mV to 10 V, the conversion error in 20 mV to 10 V range is no more than 3%, the conversion time is 6.4 ms, time of data transfer to the computer is no more than μs. The developed device made it possible to increase the stability of tomograph operation, to expand the dynamic range of signal registered and to improve a relative precision of measurements. 5 refs.; 4 figs.

28073 **(PB—88-168620/XAB) NBS (National Bureau of Standards) measurement services: alpha-particle calibrations. Final report.** Hutchinson, J.M.R. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Jul 1987. 38p. (NBS/SP—250/5). NTIS, PC A03/MF A01.

Also available from Supt. of Docs. as SN003-003-02823-1; Library of Congress catalog card No. 87-619849.

This document describes the alpha-particle calibration services offered by the Radioactivity Group of the National Bureau of Standards (NBS) (Scheduled Calibrations; 43030C and 43040C; formerly 8.2H and 8.2I). The fundamental measurement quantities are defined, the measurement approach is described (or reviewed), and the operating procedures are described from the point of view of the calibration technician or metrologist. The measurement uncertainties, and how they are estimated, are described. Methods for maintaining and assessing quality control, e.g., international comparisons, MQA programs, etc. are also briefly reviewed.

28074 **(PB—88-180666/XAB) Directory of calibration services for ionizing-radiation survey instruments. Final report.** Heaton, H.T. (National Bureau of Standards, Washington, DC (USA)). Jan 1988. 55p. (NBS-GCR—88/539). NTIS, PC A04/MF A01.

This directory provides information about calibration services for ionizing-radiation survey instruments. Its basic purpose is to tell the owner or user of a survey instrument where a calibration might be obtained. After introductory definitions of critical terms and a general description of quality assurance programs, available calibration services are listed. First, a summary of services is provided in which companies are listed alphabetically by company name and also alphabetically by state. Then a detailed list of services is provided for each type of radiation used to perform a calibration: alpha particles, beta particles, gamma rays, neutrons, and x rays. The final list shows the name, address, phone number, and person to contact for each company included in the directory.

28075 **(UFRJ-IF—23/87) Hole overlap correction and fission fragment detection efficiency in Makrofol.** Magalhaes, S.D. de; James, G.D. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). Sep 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702484/JAW.

Efficiency measurements for an SSNTD fission fragment detector have been analysed using the hole overlap correction of James et al. It is found that the measured efficiencies can be corrected, as required, to constant values which are independent of the fragment density. In the analysis the hole overlap probability is treated as a free parameter. Its dependence on fragment angle is established and examined in terms of increasing hole area with decreasing angle between the fragment and the foil.

28076 **Efficiency of barium fluoride scintillators for monoenergetic gamma rays.** Koehler, P.E.; Wender, S.A.; Moss, C.E. (Los Alamos National Lab., NM (USA)). *Nuclear Instruments and Methods in Physics Research;* **265**: No. 3, 596-597(15 Mar 1988).

We discuss the calculated and measured efficiency of barium fluoride detectors for monoenergetic gamma rays.

28077 **Portable laboratory for detection and monitoring of hazardous chemicals.** Miller, R.A. (to Secretary of the Army, Washington, DC). US Patent H431. 2 Feb 1988. Filed date 28 Nov 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a method for detecting, sampling, identifying, and quantifying hazardous chemicals and radioactive areas, without physical contact, comprising obtaining a sample of material

for on-the-spot testing, and testing the contaminated material spectroscopically.

28078 **Soft x-ray fluorescence (UHV compatible) proportional counters for NEXAFS and SEXAFS above the C,N,O, and S K edges.** Fischer, D.A.; Gland. (Brookhaven National Lab., Upton, NY (USA)). pp 504-507 of Soft x-ray optics and technology. Koch, E.E.; Schmahl, G. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-861242—).

From International conference on soft X-ray optics and technology; West Berlin, F.R. Germany (8 Dec 1986).

The authors describe the first ultra-high-vacuum-compatible soft x-ray detector for fluorescence yield (FY) detection of the near edge (NEXAFS) and extended (EXAFS) x-ray absorption fine structures above the C,N,O and S K edges. This soft x-ray proportional counter is shown to offer more than a factor of twenty increase in surface sensitivity for chemisorbed submonolayer (ML) coverage with comparable signal-to-noise as compared with any conventional electron yield detector. The FY detector allows one to record SEXAFS spectra for $\approx$5/100 ML for both sulfur and carbon. The high sensitivity of the FY technique is due to the small amount of elastically and inelastically scattered background from the sample. In addition, the characteristic fluorescence radiation from the bulk or other contaminants can easily be eliminated using standard pulse height analysis techniques. Recently, experiments were performed at the NSLS VUV storage ring demonstrating that carbon edge FY NEXAFS measurements can be performed under 1 Torr of hydrogen gas. These prototype experiments coupled a soft x-ray proportional counter, reaction cell, and suitable soft x-ray entrance window to form a system allowing the experimenter to bridge the gap between UHV surface science and real reaction conditions encountered in catalysis.

28079 **Microelectronics and microdosimetry.** Dicello, J.F. (Clarkson Univ., Potsdam, NY (USA)). pp 1044-1049 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The dimensions of electronic components have been steadily decreasing until radiation-sensitive sites are now at the micrometer level. Reduced size generally has corresponded to improved performance and increased computing speed; however, it also resulted in an unanticipated increase in vulnerability to radiation. Logic errors and failures were being produced by the alphas emitted by radioactive isotopes naturally present in the materials used in fabrication and by cosmic rays. This anomalous behavior became worse as cell densities increased. It was generally assumed that errors at sea level would be produced by neutron and muon interactions. Pions were disregarded because they represented only a small fraction of cosmic rays. Our initial estimations, however, extrapolated from microdosimetric spectra for muons and pions in hydrocarbons, indicated that pions should be more effective in producing errors than muons, even when weighted by their lower relative abundance, and may be as effective as neutrons. A series of calculations and accelerator-based experiments are in progress and indicate that indeed pions are more effective than muons. A review of error-production in microelectronics is presented along with the recent data for mesons.

28080 **Comparison of microscopic dose with average dose near high energy heavy ions.** Metting, N.F. (Pacific Northwest Lab., Richland, WA (USA)). pp 1050-1053 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract AC06-76RL01830.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Biophysical studies indicate that the mechanisms responsible for radiation effects involve injury to cell substructures much smaller than a cell nucleus. Therefore, in order to understand the molecular mechanisms responsible, it is important to know the amount of dose deposited in the microscopic volumes of interest for a particular biological endpoint. In the case of heavy ion passage through tissue, the local pattern of energy deposition in critical volumes is strongly influenced by the structure of the track. At the Bevalac in Berkeley, a small proportional counter mounted in a large vacuum chamber was used to measure single event energy deposition distributions as a function of the distance radially outward from the primary ion path, for a 1.3 μm diameter site. It was found that the distribution of energy deposited only by delta-rays in the site resembled that of 170 kVp x-rays, and also that the specific energy (microscopic dose) for those sites exceeded the calculated average radial dose by two orders of magnitude at large radial distances.

28081 **Polystyrene absorbed-dose-rate calorimeter.** Domen, S.R.; Ba, W.Z. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 1054-1057 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A simple portable calorimeter was constructed by embedding a calibrated thermistor on the axis of a polystyrene rod. This instrument was positioned on the axis of a cylindrical array of ^{60}Co rods. The duration of the measurements was $\sim$ 70 s. Absorbed dose rates of $\sim$ 70 Gy/min were measured to a daily precision of several tenths of a percent standard deviation. The results are in good agreement with earlier measurements made with a graphite calorimeter. An absorbed dose of 620 kGy resulted in no detectable change is thermistor sensitivity. The specific heat capacity of the polystyrene presumably increased $\sim$ 0.0024%/kGy. The use of a chart recorder was not necessary.

28082 **Use of a tunable quasimonoenergetic gamma-ray beam for the calibration of the egret gamma-ray telescope in the range 20-24,000 MeV.** Mattox, J.R.; Hofstadter, R.; Hughes, E.B.; Lin, Y.C.; Nolan, P.L.; Walker, A.H. (Stanford Univ., CA (USA)). pp 888-892 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

One of the three co-aligned γ-ray telescopes to be carried into space aboard NASA's Gamma Ray Observatory is the high-energy EGRET telescope. The sensitive range of this instrument extends from 20 to 24,000 MeV. A calibration of the EGRET response over its full energy range - including efficiency, angular resolution and energy resolution as a function of γ-ray arrival direction and energy - is an essential precursor to launch. A source of calibration γ-rays was provided by a backscattered laser beam that had been developed earlier at SLAC to provide quasi-monoenergetic 20 GeV γ-rays. In principle, the γ-ray energy in this beam can be reduced by lowering the electron beam energy so that, for example, a 760 MeV electron beam produces a 20 MeV γ-ray beam. The practical problems encountered in extending the operating range of the SLAC beam to low energies are described. The techniques used to monitor the γ-ray beam intensity at ten operating energies are indicated, and an overview of the EGRET calibration procedure is provided.

28083 **Some recent developments in charged particle and gamma ray detectors.** Knoll, G.F. (Univ. of Michigan, Ann Arbor (USA)). pp 1021-1027 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Significant developments have occurred over the past several years in radiation detectors available for use in accelerator-based experiments. Several are reviewed here, including trends in the application of newer inorganic scintillation materials, the use of photodiodes as substitutes for photomultiplier tubes in scintillation de-

tectors, the availability of passivated planar silicon detectors, and entirely new cryogenic detectors based on pulse mode bolometry of single radiation quanta.

28084 Measurement of the efficiency of solid state detectors using atomic-field bremsstrahlung. Altman, J.C.; Ambrose, R.; Quarles, C.A.; Westbrook, G.L. (Texas Christian Univ., Fort Worth (USA)). pp 1028-1030 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The authors report on the current status of our efforts to use the atomic-field bremsstrahlung spectrum from the bombardment of thin-film targets by an electron beam to measure the photon energy dependence of the efficiency of HPGe and Si(Li) detectors. Results are presented for an HPGe detector from 15 to 100 keV and for an Si(Li) detector from 2 to 40 keV. Points on the efficiency curve are also obtained using calibrated radioactive sources for comparison and for absolute normalization. Problems associated with the background in bremsstrahlung measurements are also discussed.

28085 BGO suppressed gamma detector arrays. Tabor, S.L. (Florida State Univ., Tallahassee (USA)). pp 1031-1034 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Arrays of a number of high-resolution γ detectors are needed to investigate the excited states of nuclei in detail, especially in coincidence experiments. The best elements currently available for such arrays use a high-resolution Ge diode detector surrounded by a high-efficiency $Bi_4Ge_3O_{12}$ (BGO) scintillator. The BGO scintillator serves to veto those events in which the incoming γ-ray undergoes Compton scattering leading to escape of the scattered photon from the Ge crystal. The first elements of a detector array at the FSU tandem-linac laboratory have been assembled with Ortec high-purity n-type Ge crystals and single crystal BGO scintillators mm long BGO split annulus is placed around the cold finger behind the Ge crystal. The performance of the array elements and repair techniques on the Ge detectors are discussed.

28086 Response of silicon detectors to ^{1}H and ^{4}He ions. Lennard, W.N.; Winterbon, K.B. (Univ. of Western Ontario, London (Canada)). pp 1035-1038 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Recent measurements of the response of Si detectors to energetic light ions (^{1}H, ^{4}He) show evidence for nonlinearity. These data are in distinct contrast to previous investigations which assumed that the energy required to create an electron-hole pair depended only on atomic number and not on energy for a given ion. A summary of experimental results relating to this topic will be given, in order to search for inconsistencies in the data. Using this comparison, further experiments capable of yielding unambiguous results are suggested.

28087 Automatic display of backscattered ion spectra. Butler, J.W. (Naval Research Lab., Washington, DC (USA)). pp 1039-1043 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The present paper describes the principal features of a computer program that provides flexible graphics capability for presimulation inspection of the experimental energy spectra of scattered high-energy helium ions for materials analysis purposes. Experimental spectra from nine samples can be immediately displayed on an external color monitor with a variety of linear and logarithmic y-axis scales representing counts/channel. x-axis-scale options include channel number, energy, mass of surface atoms, and depth of atoms of a selected mass. The spectra from two detectors (backward and glancing) may be displayed concurrently or sequentially. Cursors provide automatic numeric readouts of the locations of spectrum features along any selected combination of x and y scales. In addition to the location of the cursor on the mass scale, the screen also displays a live readout of concomitant chemical element symbols for immediate identification.

28088 Electrochemical development of particle tracks in CR-39 polymer dosimeters. Hadlock, D.E.;Parkhurst, M.A.;Yang, C.S.;Groeger, J.;Johnson, J.F.;Huang, S.J. (Battelle Pacific Northwest Lab., Richland, WA (USA);Connecticut Univ., Storrs (USA). Inst. of Materials Science). *Nuclear Tracks and Radiation Measurements;* **12**: No. 1-6, 185-187(1986). (CONF-850933—).

From 13. international conference on solid state nuclear track detectors; Rome, Italy (23 Sep 1985).

Electrochemical etching of CR-39 polymeric track etch neutron detectors results in proton-recoil tracks which can be distinguished from background tracks much better than tracks developed solely by chemical etching. A newly designed and constructed electrochemical etching apparatus allows large numbers of dosimeters to be processed simultaneously with consistent results. Many processing systems have been developed for chemical and electrochemical etching of the track etch dosimeters. Three systems specifically show great promise and are being studied extensively.

28089 ^{3}H-gas scintillation spectrometer for fusion-neutron measurements. Derzon, M.S. Berkely, CA; Univ. of California (1986). 169p. University Microfilms Order No. 87-17,958.

Thesis (Ph. D.).

A high-pressure, ^{3}He Gas Scintillation Spectrometer (^{3}He-GSS) was developed for measurement of the neutron energy spectra from D-D fusion in magnetically confined plasmas. The spectrometer exhibits an energy (FWHM) resolution of (110 +/- 15) keV, an efficiency of (1.9 +/- 0.4) x 10^{-3} counts/(n/cm^{-2}) and a scintillation decay time of 125 +/- 25) ns. These results were obtained for nominally 2.5-MeV neutrons when the gas scintillation chamber was filled with 13.6 atm of Xe and 13.6 atm of ^{3}He. The dominant factors determining energy resolution were identified to be the position dependence of the light-collection efficiency and the statistical fluctuations in the number of photoelectrons obtained per neutron event. A significant degradation of the resolution and symmetry of the 2.5-MeV neutron peak is observed. Calculations simulating the effects of photon transport and light collection on detector response were made. This work reports the results of measurements to determine the absolute value of the energy deposited in the scintillation gas per photon generated for protons and tritons stopping in xenon gas. Relative light yields for gas mixtures commonly used in gas scintillators are also reported. The contribution to the measured resolution (FWHM) from photoelectron-counting statistics was estimated to be 35 +/- 8 keV) for 2.5-MeV neutron events in the He-Xe filled spectrometer.

4402 Radiation Effects On Instrument Components,

Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 28099

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 27430, 27448, 28298, 28362, 28363

28090 (CERN—87-13) Pseudospark switches. Billault, P.; Riege, H.; Gulik, M. van; Boggasch, E.; Frank, K.; Seeboeck, R. (European Organization for Nuclear Research, Geneva (Switzerland); Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Physikalisches Inst.; Siemens A.G., Erlangen (Germany, F.R.)). (European Organization for Nuclear Research, Geneva (Switzerland)). 14 Dec 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702227/JAW.

The pseudospark discharge is bound to a geometrical structure which is particularly well suited for switching high currents and voltages at high power levels. This type of discharge offers the potential for improvement in essentially all areas of switching operation: peak current and current density, current rise, stand-off voltage, reverse current capability, cathode life, and forward drop. The first pseudospark switch was built at CERN at 1981. Since then, the basic switching characteristics of pseudospark chambers have been studied in detail. The main feature of a pseudospark switch is the confinement of the discharge plasma to the device axis. The current transition to the hollow electrodes is spread over a rather large surface area. Another essential feature is the easy and precise triggering of the pseudospark switch from the interior of the hollow electrodes, relatively far from the main discharge gap. Nanosecond delay and jitter values can be achieved with trigger energies of less than 0.1 mJ, although cathode heating is not required. Pseudospark gaps may cover a wide range of high-voltage, high-current, and high-pulse-power switching at repetition rates of many kilohertz. This report reviews the basic researh on pseudospark switches which has been going on at CERN. So far, applications have been developed in the range of thyratron-like medium-power switches at typically 20 to 40 kV and 0.5 to 10 kA. High-current pseudospark switches have been built for a high-power 20 kJ pulse generator which is being used for long-term tests of plasma lenses developed for the future CERN Antiproton Collector (ACOL). The high-current switches have operated for several hundred thousand shots, with 20 to 50 ns jitter at 16 kV charging voltage and more than 100 kA peak current amplitude.

28091 (JINR—13-87-608) Programmed pulse generator. Vasil'ev, S.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702426/JAW.

A universal CAMAC generator of pulses designed to control the operation of physical setups and automation systems on-line with a mini (micro)-computer is described. Operating modes are the following: a monovibrator, a multivibrator and a rate generator with programmed time parameters and a real time clock. The application of BIS KR58OVI53 with counters connected in series allows one to obtain a broad time range of (1x10/sup -6/-3x10/sup 8/ s). 8 refs.; 2 figs.

28092 (JINR-R—13-87-468) Mesooptical Fourier-transform microscope for the observation of relativistic neon nuclei. Soroko, L.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702460/JAW.

Experiments on observation of relativistic neon nuclei in nuclear emulsion by means of the Mesooptical Fourier-Transform Microscope (MFTM) with a cylindrical lens as a mesooptical element are described. Mesooptical images of straight-line particle tracks are focused along the angular coordinate with a Fourier-Transform lens and along the radial coordinate with a cylindrical lens. In a small range of orientation angles the mesooptical images of relativistic neon nuclei have the form of blurred points. The monocular stereoeffect is observed if we vary the observation angle. The problem of resolving power and optimal conditions for observation are dealt with in terms of information degrees of freedom. The method described here can also be used to observe the tracks of heavier relativistic nuclei. 13 refs.; 12 figs.

28093 (JINR-R—13-87-594) Apodization in mesooptics. Bentse, D.; Soroko, L.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702461/JAW.

Apodization effects in mesooptics, induced by the natural screening pupil of the mesooptical element, are treated. The apodization effects in a traditional optical system and in a scanning confocal microscope are considered. The definition of the point spread function in mesooptics is formulated. The computer simulated calculations of the apodization effects in the mesooptical Fourier-transform microscope (MFTM) are described. Three classes of the input signals are investigated: rectangular pulse, bell cosine and gaussian. It is shown that in the MFTM with acylindrical lens a knife-edge effect is observed. In the MFTM with a torric mirror the contouring effect for the wide recatngular pulse is observed. However for bell cosine and for gaussian this effect is absent. 24 refs.; 13 figs.

28094 Sensitivity improvement of a Varian E-109 EPR spectrometer with a low noise microwave amplifier. Dexheimer, S.L.; Klein, M.P. (Department of Physics, University of California, Berkeley, and Chemical Biodynamics Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Review of Scientific Instruments;* **59**: No. 5, 764-766(May 1988). Contract AC03-76SF00098.

The installation of a low noise GaAsFET microwave preamplifier into a Varian E-109 homodyne X-band EPR spectrometer is described, and measurements of the resulting improvement in sensitivity as a function of microwave power are presented. Particular attention is paid to modification of the automatic frequency control (AFC) system to compensate for the preamplifier gain, which would otherwise result in instability of the AFC servoloop and decreased spectrometer performance at moderate microwave power levels. Specific details are provided for modification of the Varian E-102 bridge, but the general approach is applicable to other spectrometers.

28095 X-ray and optical profiler analysis of electroformed x-ray optics. Matsui, Y.; Ulmer, M.P.; Takacs, P.Z. (Northwestern University, Department of Physics & Astronomy, Evanston, Illinois 60208). *Applied Optics;* **27**: No. 8, 1558-1563(15 Apr 1988).

Electroformed grazing incidence mirrors were tested with x rays and were measured with an optical profiler. Their total effective areas are approx. >70% of the theoretical values both for 1.5- and 6.4-keV x rays. The half-power diameters (HPDs) are approx. <2 min of arc at 1.5 keV. Comparing the x-ray test result with the optical measurement, we set requirements of high-frequency roughness <14 A and a midfrequency roughness <70 A for a HPD < 1.5 min of arc at 7 keV. We also present a design of the mirror array telescope for high energies (MARTHE) which has a total effective area of ~1000 cm^2 for 7-keV x rays.

45 EXPLOSIONS AND EXPLOSIVES

4502 Nuclear

REFER ALSO TO CITATION(S) 27688, 27689, 27690, 27963, 27964, 27997, 27998, 28359

28096 (AD-A—187678/8/XAB) Anti-nuclear attitudes in New Zealand and Australia. Alves, D. (National Defense Univ., Washington, DC (USA)). Dec 1985. 93p. NTIS MF A01.

Availability: Superintendent of Documents, GPO, Washington, DC 20402 FC $2.25 Stock no. 008-020-01053-7. Microfiche furnished to DTIC and NTIS users.

The vast South Pacific, so near to Southeast Asia and vital sea lines of communications, is of great strategic value to the United States and the West. Peace in the South Pacific has depended on regional cooperation, primarily under ANZUS-the alliance of Australia, New Zealand, and the United States. But New Zealand broke alliance ranks when it refused in early 1985 to allow a US ship to call at its ports following an ANZUS sea exercise. Coupled with the stern US response of suspending military cooperation with New Zealand, the incident threw into doubt the future of the South Pacific accord. This monograph, by Dr. Dora Alves of the National Defense University, examines the regional events leading to New Zealand's action and the resulting furor. Because the center of the incident is the issue of nuclear arms, Dr. Alves focuses on the growth of anti-nuclear attitudes in New Zealand, where the ruling Labour Party adopted an anti-nuclear stance as policy. Dr. Alves' work is both a case study of the interaction of domestic politics with international treaty obligations and a discussion of the strong anti-nuclear attitudes of many South Pacific inhabitants.

28097 **(AD-A—187722/4/XAB) Changing soviet doctrine on nuclear war. Final report.** FitzGerald, M.C. (Center for Naval Analyses, Alexandria, VA (USA). Naval Warfare Operations Div.). Oct 1986. 78p. (CRM—86-234). NTIS, PC A05/MF A01.

In January 1977, General Secretary L. I. Brezhnev delivered an address in the city of Tula whose impact on Soviet doctrine and capabilities continues to this day. By rejecting the possibility of a means of defense against nuclear weapons, or a damage-limiting capacity in nuclear war, Brezhnev closed the door on a debate that had lasted for over a decade in Soviet military thought. Since Tula, the Soviet politico-military leadership has presented a consensus on the reality of Mutual Assured Destruction in present-day conditions. The Soviet debate on the viability of nuclear war as an instrument of policy was likewise resolved by a consensus: nuclear war is so unpromising and dangerous that it remains an instrument of policy only in theory, an instrument of policy that cannot be used. While the Soviet consensus on the diminishing military utility of nuclear weapons represents a ground-breaking shift in doctrine since the heyday of Marshal Sokolovskiy, there is scant evidence of any dispute on the new correlation of war and policy in a nuclear age. Marshal N. V. Ogarkov and other hard-minded military figures have themselves emerged as the architects of the Soviet shift away from a nuclear war-fighting and war-winning strategy, while General Secretary Gorbachev has fashioned a corresponding arms control agenda.

28098 **(AD-A—188110/1/XAB) Laboratory fire modeling. 1. Wind-aided flame spread. 2. Wet coagulation of smoke. Technical report, 4 April 1985-21 November 1986.** Beach, K.L.; Carrier, G.F.; Fendell, F.E.; Gat, N.; Hsu, C.T. (TRW Electronics and Defense Sector, Redondo Beach, CA (USA)). 21 Nov 1986. 88p. NTIS, PC A05/MF A01.

Design, construction, instrumentation, and preliminary utilization were carried out for two laboratory-scale apparati concerned with specific incendiary effects in a thermonuclear aftermath. One apparatus is a fire tunnel dedicated to wind-aided fire propagation across a regular two-dimensional array of discrete polymeric fuel elements (specifically, toothpicks). This work is dedicated to quantifying a local incendiary effect, the rate of fire spread across strewn debris in the presence of an ambient wind. Preliminary findings suggest that the rate of spread increases directly as the square root of the wind speed and inversely as the square root of the fuel loading, for conditions for which spread occurs at all.

28099 **(AD-A—188193/7/XAB) Nuclear-hardness management. Technical report.** van Lint, V.A.; Burke, E.A.; Cotter, L.D.; Morris, G.C. (Mission Research Corp., San Diego, CA (USA)). 28 Feb 1986. 168p. (MRC/SD-R—174). NTIS, PC A08/MF A01.

An approach to formalizing nuclear-hardness validation for electronic equipments is presented. It uses margins, defined methods, standards and formalized rules for constructing the simplest validation methodology from available methods.

28100 **(AD-A—188194/5/XAB) Environment of the long-range theater nuclear-force program, its opponents, and the effects of specifics of the program on opposition. Technical report, 15 August 1982-7 June 1983.** Armbruster, F.E.; Yokelson, D.; Clemmons, C.; Guthe, K.; Kahn, H. (Hudson Inst., Inc., Indianapolis, IN (USA)). 7 Jun 1983. 391p. (HI—3585/3-RR). NTIS, PC A17/MF A01.

This report examines West European opposition to the modernization of NATO intermediate-range nuclear forces (i.e., the deployment of Pershing-2 ballistic missiles and ground launches cruise missiles). Notable differences between U.S. and European perceptions of the peace movement are discussed.

28101 **(AD-A—188275/2/XAB) Strategic planning for counterforce options. Final report, April-June 1987.** Palumbo, N.R. (Naval Postgraduate School, Monterey, CA (USA)). 4 Nov 1987. 47p. (NPS—56-87-003). NTIS, PC A03/MF A01.

The first objective of this report is to explore the disparity between United States declaratory policy and actual force capabilities. This report will secondarily pose questions and purpose decision-making criteria that are essential to ensure successful future nuclear strategic force employment and planning. This report is primarily concerned with the gap in U.S. declaratory and operational (or action) policy as it applies to current counterforce targeting problems. It is important to distinguish between declaratory policy and actual operational policies to appreciate the complexities of the debate and to resolve questions concerning future force planning.

28102 **(PB—88-157961/XAB) NSEP (National Security/Emergency Preparedness) fiber-optics system study, background report: nuclear effects on fiber-optic transmission systems.** Hull, J.A. (Department of Commerce, Boulder, CO (USA). Inst. for Telecommunication Sciences). Nov 1987. 116p. (NTIA—87-227). NTIS, PC A06/MF A01.

The National Communications System (NCS) is responsible for defining reasonable enhancements that could be applied to commercial common carrier (or carriers'- carrier) fiber-optic systems that will be leased or owned by government agencies and which may be used for National Security/Emergency Preparedness (NSEP) purposes. This report provides background excerpted from many references used in the development of a multitier specification that identifies five levels of enhancement. (The multitier specification is presented in a separate report.) The report describes the nuclear environment for surface and in-atmosphere bursts outside of the blast region, where buildings and personnel would be expected to survive. In the environment, the vulnerability of optical fiber waveguides to fallout radiation is a primary concern. An assessment of fiber darkening, based on a review of unclassified literature, is presented. For exo-atmospheric nuclear bursts, the fiber optic system is exposed to High Altitude electromagnetic pulse (HEMP) radiation. Unclassified levels of these nuclear effects have been obtained from published literature. The characteristics of future generations of optical-fiber systems, as described in current literature, are outlined.

28103 **(PB—88-858477/XAB) Nuclear warfare: survival. January 1970-February 1988 (Citations from the NTIS data base). Report for January 1970-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 186p. NTIS PC N01/MF N01.

Supersedes PB—87-855003.

This bibliography contains citations concerning various factors and systems relating to both military and civilian personnel and general survival in nuclear warfare. Vulnerability and security of people, material, and systems are considered as well as their survivability. A wide variety of studies and analyses, many of them based upon computerized simulations, are included. (This updated bibliography contains 346 citations, 40 of which are new entries to the previous edition.)

28104 **Operating characteristics and scaling of the LLNL 100 KV electric gun for hypervelocity flat-plate impact applications.** Osher, J.E.; Basu, P.K.; Chau, H.H.; Chato, D.M.; Diaz, R.E.; Gathers, G.R.; Lee, C.G.; Lee, R.S.; Lindemuth, I.R.; Weingart, R.C. pp 109-110 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Electric guns using exploding metallic foils to drive flat-plate flyers have been in wide use at LLNL for slapper detonation studies since 1966. The principles of operation of the newest 100 kV electric gun are modeled and the predicted flyer performance compared to the database accumulated in recent experiments. The results indicate that the exploding foil driven flyer is energy limited. The total flyer energy is a slowly varying efficiency factor times the total capacitor bank energy, where the efficiency factor depends upon the gun barrel diameter and length, the velocity history of the flyer in the barrel, the current rise time from the supply capacitor bank, and the circuit resistance.

4503 Explosion Detection

28105 **(AD-A—188212/5/XAB) Studies in decoupling. Annual report, March 1985-September 1987.** Gupta, I.N.; McLaughlin, K.L.; Wagner, R.A.; McElfresh, T.W.; Marshall, M.E. (Teledyne Geotech, Alexandria, VA (USA). Alexandria Labs.). Nov 1986. 79p. (TGAL—86-08). NTIS, PC A05/MF A01.

This report contains studies on seismic decoupling using Salmon, Sterling, and Pahute Mesa Nuclear Explosions, and on strain and frequency-dependent attenuation estimates in salt from Salmon and Sterling near-field recording. An understanding of the frequency dependence of decoupling is essential for monitoring nuclear explosions detonated in large underground cavities. Analysis of available data from the nuclear explosions Salmon and Sterling recorded at shot-receiver distances of 16, 32, and 27 km, confirmed earlier findings of Blandford and Woolson indicating: 1) reduced decoupling of Sterling at higher frequencies for both P and L, and (2) relatively greater decoupling of Sterling for lL than for P at high frequencies. In an attempt to understand why the frequency dependence of the decoupling ratio is different for P and Lg group, we examined the spectral content of Pn and Lg from 7 Pahute Mesa, NTS explosions covering a wide range of scaled depths and recorded at a common station, KN-UT. The spectral ratio Pn/Lg varied strongly with scaled depth, mainly due to significantly greater dependence on scaled depth of the spectra of Pn than of Lg. These results are in agreement with those from Salmon and Sterling. A possible reason for the decoupling at higher frequencies to be different for P and LG may be the greater scaled depth of decoupled shots. The Spectral ratio Pn/Lg may be useful in discriminating between decoupled (or overburied) and normal shots.

28106 (SAND—87-1343-Vol.11-No.2, pp 28-29) **Another US seismic array is installed in Norway.** Dec 1987. NTIS, PC A03/MF A01. Order Number DE88005955/JAW.

In Sandia technology: Volume 11, No. 2.

During September 1987, a second seismic array was installed near Karasjok, Norway to improve the capability to study seismic events such as earthquakes and underground nuclear explosions; the first array (NORESS) was installed in 1984 near Hamar, 100 km north of Oslo. The second array consists of 25 seismometers arranged around a hub; they are placed along four concentric circles whose diameters increase exponentially to 3 km. Twenty-one of the instruments are vertical-axis and four are three-axis, each operating in the 10- to 1-Hz range. The seismometers are specially designed to detect seismic waves characteristic of underground explosions and small earthquakes at regional distances - within 2000 km. 3 figures.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 28166, 28176, 28305, 28306

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 27471, 27583, 27618, 27638, 27659, 27661, 27897, 27898, 27899, 27900, 27901, 27914, 27962, 27984, 28210, 28214, 28215, 28282, 28284, 28287, 28288, 28289

28107 **(AD-A—187839/6/XAB) Optical characterization of tropospheric aerosols. Technical report, January 1981-December 1982.** Carlon, H.R. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). Sep 1987. 25p. (CRDEC-TR—87070). NTIS, PC A03/MF A01.

Complex calculations of optical scattering using high-speed electronic computers have become so commonplace that the technology has evolved into several specialty fields, e.g., extinction spectroscopy, angular scattering measurements, and nephelometry. As a consequence, the overall technology and our ability to remotely characterize or quantitatively analyze atmospheric aerosols might be further advanced than realized by workers in the individual disciplines who do not have the time to keep up with advances in other disciplines. This report examines techniques of transmission (extinction) and turbidity spectroscopy, polarization, and angular scattering measurements and related developments, and concludes that computer programs can be written to optimize desired parameters in interdisciplinary investigations.

28108 **(AD-A—188191/1/XAB) Stack-emission testing for beryllium, Hill AFB, Utah. Final report, 13-17 July 1987.** Daly, M. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Nov 1987. 54p. (USAFOEHL—87-144EQ0086LEF). NTIS, PC A04/MF A01.

At the request of HQ AFLC/SGB, personnel from the USAFOEHL conducted an air-emission survey of the exhaust from a C-5 brake reconditioning operation at Hill AFB UT from 13 July to 17 July 1987. These brakes contain beryllium disks and during the reconditioning process, beryllium particles are generated. The reconditioning operation consists of two processes which vent to individual stacks. The emissions for both stacks were well below the EPA standard for this kind of operation. The brake shop conducts a two part reconditioning operation on C-5 beryllium brake discs. This operation consists of an active wet grinding process and a wet dipping process. The reconditioning process is a cyclic operation for six hours per day and the shop operates only one shift per day. Each process is exhausted through its own stack and has no air pollution control equipment.

28109 **(AD-A—188375/0/XAB) Numerical simulation of near-surface environments and particulate clouds generated by large-area fires. Technical report, 3 November 1982-22 December 1986.** Marcus, S.L.; Krueger, S.K.; Rosenblatt, M. (California Research and Technology, Inc., Chatsworth (USA)). 24 Aug 1987. 123p. (CRT—3880F). NTIS, PC A06/MF A01.

The near-surface environments and lofted particulate clouds produced by large-area fires were simulated with the axisymmetric DICE code. Studies with an inviscid version of the model showed that variations in the assumed area and burning rate of the fire have a strong effect on the maximum inflow winds, temperatures, and plume heights that develop. Using a multiphase version of the model, which predicts concentrations of soot, water vapor, liquid water, and ice, it was found that the particulate clouds generated by large-area fires show considerable vertical dispersion, and that latent heat released by condensing water vapor can significantly enhance cloud heights. When the grid is changed from finely zoned to coarsely zoned, the effective mixing of the combustion heating

over a greater depth generates cooler maximum temperatures, causing the plume to shift from oscillatory (overshooting) behavior to a steady-state regime. When the mixing is explicity accounted for by introducing parameterized turbulence, steady-state behavior results for the finely zoned cases as well. Using an extended version of DICE that includes a tangential velocity component, an initial swirl velocity of 10 m/sec at the edge of a 10-km radius fire was found to spin up to swirl velocities in excess of 200 m/sec in the inflow layer near the axis of the fire. Plume heights for this case, which allowed no interaction of swirl with turbulence, were about 3-km lower than a corresponding nonrotating case.

28110 **(AD-A—188797/5/XAB) Observations on electrostatic effects in a filter test system. Technical note.** Coleman, J.R. (Defence Research Establishment, Ottawa, Ontario (Canada)). Jun 1987. 36p. (DREO-TN—87-18). NTIS, PC A03/MF A01.

The filter-test system FTS 400 was used to examine a variety of filter papers, using sodium chloride and dioctylphthalate as aerosols challenges. In nearly every case, minimum in penetration was observed at particle size in the vicinity of 0.02 micrometers. In the same region NaCl particles (but not DOP droplets) exhibited substantial in-line losses that could affect measured penetration results. Introduction of a radioactive neutralizer that removes most of the particle charge greatly reduced line losses. The effect of introducing the neutralizer on penetration was studied, using several types of filter paper. Conventional filter papers showed slight increase in penetration over the size range up to 0.3 micrometers. With electrets, which depend on electrical attraction for their effectiveness, introduction of a neutralizer increased penetration in the same range by several orders of magnitude.

28111 **(CEA-CONF—9058) Atmospheric CO/sub 2/ variations over the last climatic cycle (160.000 years) deduced from the Vostok ice core.** Barnola, J.M.;Raynaud, C.;Lorius, J.;Korotkevitch, Y.S.;Genthon, C.;Jouzel, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Apr 1987. 4p. (CONF-8703252—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752594/JAW.

From Congress on ice core; Bern, Switzerland (30 Mar 1987).

28112 **(PB—88-144316/XAB) Effect of low level carbon monoxide on compensatory tracking and event monitoring.** Benignus, V.A.; Muller, K.E.; Barton, C.N.; Prah, J.D. (North Carolina Univ., Chapel Hill (USA)). 1987. 10p. NTIS, PC A02/MF A01.

Pub. in Neurotoxicology and Teratology, Vol. 9, 227-234(1987).

Experiments by Putz et al. concerning the effect of carbon monoxide (CO) exposure on compensatory tracking and monitoring in healthy young men were replicated. Task and procedural variables were reproduced as closely as practical. Subjects were exposed to either room air or 100 ppm CO. Mean carboxyhemoglobin (COHb) levels in the high-CO exposure groups were 5.1% for Putz et al. (70 ppm exposure), and 8.24% for this study (100 ppm exposure). In both studies, elevated COHb produced a statistically significant increase over time in log mean absolute deviation scores (tracking error) with respect to control groups. The magnitude of the effect was smaller in the present study, perhaps because of subtle methodological or training differences between studies. The relationship between task difficulty and magnitude of CO-induced dysfunction remains unresolved. In contrast to Putz et al., no statistically significant effect of COHb in monitoring behavior was found. The failure to replicate the feature may reflect the large differences in baseline performance, and higher variance in the present study.

28113 **(PB—88-148929/XAB) Spatial and temporal distribution of precipitation chemistry across Maryland in 1984. Volume 1.** Maxwell, C.; Mahn, S. (Versar, Inc., Columbia, MD (USA)). Sep 1987. 112p. NTIS, PC A06/MF A01.

See also Volume 2, PB—88-148937.

This report presents the results of a study, conducted from January to June 1987, in which existing deposition data for 1984 were colligated, examined for quality and consistency, and used to examine the temporal and spatial distribution of deposition and concentration for the chemical species collected in precipitation across Maryland and surrounding regions.

28114 **(PB—88-148937/XAB) Spatial and temporal distribution of precipitation chemistry across Maryland in 1984. Volume 2.** Maxwell, C.; Mahn, S. (Versar, Inc., Columbia, MD (USA)). Sep 1987. 442p. NTIS, PC A19/MF A01.

See also Volume 1, PB—88-148929.

Summary statistics include; January through March: Total precipitation, average concentrations, pH, and total depositions; April through June: Total precipitation, average concentrations, pH, and total depositions; July through September: Total precipitation, average concentrations, pH, and total depositions; October through December: Total precipitation, average concentrations, pH, and total depositions; January through June: Total precipitation, average concentrations, pH, and total depositions; July through December: Total precipitation, average concentrations, pH, and total depositions; monthly total precipitation, average concentrations, pH, and total depositions.

28115 **(PB—88-157805/XAB) Acid deposition in Maryland: the status of knowledge in 1987. Annual report.** (Maryland Power Plant Research Program, Annapolis (USA)). Jan 1988. 239p. (PPRP/AD—88-1). NTIS, PC A11/MF A01.

See also PB—87-218764.

The Power Plant Research Program coordinates Maryland's acid deposition research and reports research results annually. The report evaluates several major topic areas including transport and chemistry of acid deposition its potential impacts on the State's streams and fish, possible impacts on terrestrial resources such as crops and forests and on materials, the ability of energy-conservation programs to reduce emissions of acid-forming pollutants, and mitigation techniques for neutralizing acid waters.

28116 **(PB—88-157896/XAB) Volatile Organic Compound Emission Projection Model (Version 1.8). User's manual. Final report.** Jennings, M.S.; Emmel, T.E. (Radian Corp., Research Triangle Park, NC (USA)). Dec 1987. 95p. NTIS, PC A05/MF A01.

For system on diskette, see PB—88-157888.

This report discusses a model that can be used to estimate future emissions of volatile organic compounds (VOCs) and costs of their control by applying growth factors, emission constraints, control cost functions, and capacity-retirement rates to the base-line estimates of VOC emissions and industrial VOC source capacity in 1980. A personal computer model was developed to automate the forecasting procedure. The report provides guidelines for installing and operating the Volatile Organic Compound Model (VOCM) on an IBM-PC or IBM compatible computer. The report describes the creation of data files by a VOCM user and the use of data files supplied with the VOCM for preparing forecasts.

28117 **(PB—88-158761/XAB) Stability of parts-per-million organic cylinder gases and results of source-test analysis audits: status report number 9.** Howe, G.B.; Albritton, J.R.; Sokol, C.K.; Jayanty, R.K.M.; Decker, C.E. (Research Triangle Inst., Research Triangle Park, NC (USA). Center for Environmental Measurement). Jan 1988. 98p. NTIS, PC A05/MF A01.

See also PB—87-141461.

A repository of 45 gaseous compounds including hydrocarbons, halocarbon, and sulfur species was established under contract with the U.S. Environmental Protection Agency (USEPA). The main objectives of the on-going project are (1) to provide gas mixtures to EPA, state/local agencies, or their contractors, as performance audits to assess the accuracy of source emission measurements in certain organic chemical manufacturing industries, (2) to examine the vendor's certified analysis of the gas mixtures by in-house analysis, (3) to determine the stability of the gas mixtures with time by in-house analysis, and (4) to develop new audit materials as needed. Thus far, 31 compounds have been used to conduct 214 different audits. The results of these audits and a description of the experimental procedures used for analyses and available stability data are

presented in the status report. Generally the audit results are within 15 percent of the expected values.

28118 (PB—88-158779/XAB) Florida acid-deposition study: five-year data summary. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). Oct 1987. 228p. (ESE—85-186-0106-2110). NTIS, PC A11/MF A01.

See also PB—86-243318.

In November 1980, the Florida Acid Deposition Study was initiated by the Florida Electric Power Coordinating Group, Inc. (FCG). The overall objective of that study was to develop and evaluate Florida-specific information on acid deposition in three major program areas: acid-deposition monitoring, source attribution, and ecological effects. The study formally ended in August 1985 with the peer review and publication of a report that synthesized data from all three program areas. The study made significant progress is understanding patterns of acid deposition in Florida. However, additional data were needed to evaluate year-to-year variability and near-term trends. Based on the conclusion, as well as the recommendations of peer reviewers, the Acid Deposition Monitoring Program was continued. Analyses were expanded to include ozone, hydrogen peroxide, and nitrous acid.

28119 (PB—88-158811/XAB) Options for controlling condensation aerosols to meet opacity standards. Damle, A.S.; Ensor, D.S.; Sparks, L.E. (Research Triangle Inst., Research Triangle Park, NC (USA)). 1987. 11p. NTIS, PC A03/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 37, No. 8, 925-933(Aug 1987).

The article gives results of an analysis of the condensing aerosol problem and an evaluation of possible control approaches to reduce the downwind detached plume opacity. The opacity of such plumes may be reduced by reducing the concentration of condensible vapors, the in-stack concentration of fine particles, or both. Results of the analysis indicate that, for low concentrations of condensible vapors, the detached-plume opacity may be adequately controlled by reducing the in-stack fine-particulate concentration alone. For high concentrations of condensible vapors, however, reduction of in-stack fine particulate concentration alone may not be effective: reduction of vapor concentration may be necessary along with particulate removal for adequate reduction of plume opacity. Different combinations of levels of reduction of vapor concentration and particulate-phase concentration are possible to achieve a desired result; and thus may be optimized to obtain a cost-effective combination.

28120 (PB—88-158951/XAB) Evaluation of control strategies for volatile organic compounds in indoor air. Report for May 1986-June 1987. Ramanathan, K.; Debler, V.L.; Kosuso, M.; Sparks, L.E. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jan 1988. 22p. NTIS, PC A03/MF A01.

The Air and Energy Engineering Research Laboratory of the U.S. Environmental Protection Agency (U.S. EPA) conducts and sponsors research on technology to reduce or eliminate emissions of potentially toxic volatile organic compounds (VOCs) from industrial/commercial sources. The realization that indoor air environments, where most humans spend the majority of their time, also contain significant levels of VOCs has led to a number of EPA-sponsored studies on monitoring, modeling, and controlling these compounds. The purpose of the paper is twofold: (1) to present an overview of the problem of indoor air pollution by VOCs and approaches to solving it; and (2) to report the results of a study to determine the feasibility of carbon adsorption for control of VOCs in indoor air.

28121 (PB—88-158969/XAB) WYNDvalley: an air-quality model for near-stagnant flows in constricted terrain. Harrison, H. (WYNDsoft, Inc., Mercer Island, WA (USA)). 17 May 1987. 94p. NTIS, PC A05/MF A01.

The mathematics of air-quality modeling is discussed with special attention to problems associated with complex terrain. Practical solutions to some of these problems are suggested and an implementation is described as WYNDvalley, a dispersion model adapted to the study of trace-species concentrations in near-stagnant conditions within complex valley drainage systems. The model is illustrated by application to the Methow, Twisp, and Chewack valleys of Okanogan County, Washington.

28122 (PB—88-159629/XAB) Impact of mesoscale convective systems on regional visibility and oxidant distributions during persistent elevated pollution episodes. Lyons, W.A.; Calby, R.H.; Keen, C.S. (MESOMET, Inc., Chicago, IL (USA)). 1986. 15p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Climate and Applied Meteorology, Vol. 25, 1518-1531(Nov 1986).

Atmospheric pollutants can be transported over large distances, with sources impacting on receptors more than 1000 km downwind. The redistribution and removal of various pollutant species may be significantly controlled by mesoscale phenomena, such as mesoscale convective systems (MCS). A case study (1-2 August 1980), using data from PEPE/NEROS-80, reveals the dramatic impact of several types of MCS (MCC, squall line, air-mass shower cluster) on regional ozone and visibility. In the air mass traversed by the MCS, afternoon ozone was significantly depleted (less than 20-40 ppb vs 100-120 ppb in the polluted regional air mass.) Visibilities, which prior to the wind shift/rain had typically been 4-13 km rose in a matter of a few hours to 27-56 km at many locations. This CARE (convective aerosol removal event) covered Virginia, northern North Carolina, Delmarva, and extended more than 500 km into the Atlantic, as clearly shown by GOES satellite imagery on the morning of 1 August 1980.

28123 (PB—88-159637/XAB) Radiative-transfer budgets for scattering and absorbing plumes: measurements and model predictions. Wilson, W.E.; White, W.H.; Seigneur, C.; Heinold, D.W.; Richards, L.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 17p. (EPA—600/J-86/440). NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 20, No. 11, 2243-2257(Nov 1986).

The 1981 VISTTA field study characterized the composition and appearance of particle-rich plumes from three different sources. The paper examines the VISTTA observation from the perspective of an idealized theory, and compares them with the predictions of two plume visibility models. The optics predictions of the two models are less accurate for plumes dominated by particle scattering than they are for plumes dominated by NO_2 absorption. Inaccurate prediction of plume particle-size distributions can be identified as one important source of error.

28124 (PB—88-159678/XAB) Predicting the visibility of chimney plumes: an intercomparison of four models with observations at a well-controlled power plant. Conner, W.D.; Wilson, W.E.; White, W.H.; Seigneur, C.; Heinold, D.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). 1985. 16p. (EPA—600/J-85/517). NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 19, No. 3, 515-528(Mar 1985).

Four models for the operational prediction of plume visibility have been run by their developers on data from the VISTTA field study at the Navajo Generating Station. The different models give substantially different predictions of plume dispersion, cross-plume concentration integrals, and plume-sky contrast. Two of the models predict plume-sky contrasts that differ qualitatively from those observed. Overall model performance is limited chiefly by dispersion module performance; given observed concentration integrals as inputs, three of the models correctly predict the qualitative features of observed contrast. Much of the observed variation in plume dispersion and concentration integrals appears to have been due to sub-scale fluctuations in atmospheric transport and source emissions. The effects of particles on observed plume contrast were less than the experimental uncertainty.

28125 **(PB—88-159686/XAB) Sampling and analysis methods for use in source-apportionment studies to determine impact of wood burning of fine-particle mass.** Stevens, R.K. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). 1985. 15p. (EPA—600/J-85-518). NTIS, PC A03/MF A01.

Pub. in Environmental International, Vol. 11, 271-283(1985).

Aerosol sampling and analysis procedures are described which may be used to obtain ambient-air measurements for input into source-apportionment studies to estimate the impact of wood burning on ambient particulate loadings. Ambient wintertime fine-particle compositions in Denver and Albuquerque are used as examples for receptor model calculations.

28126 **(PB—88-159744/XAB) Applied dispersion modelling based on meteorological scaling parameters.** Irwin, J.S.; Gryning, S.E.; Holtslag, A.A.M.; Sivertsen, B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 13p. (EPA—600/J-87/176). NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 1, 79-89(Jan 1987).

A method for calculating the dispersion of plumes in the atmospheric boundary layer is presented. The method is easy to use on a routine basis. The inputs to the method are fundamental metereological parameters, which act as distinct scaling parameters for the turbulence. The atmospheric boundary layer is divided into a number of regimes. For each scaling regime the authors suggest models for the dispersion in the vertical direction. The models directly give the crosswind-integrated concentrations at the ground for nonbuoyant releases from a continuous point source. The method is limited to horizontally homogenous condition and travel distances less than 10 km.

28127 **(PB—88-159769/XAB) Wind-tunnel study of the flow structure and dispersion from sources upwind of three-dimensional hills.** Snyder, W.H.; Britter, R.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 19p. (EPA—600/J-87/175). NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 4, 735-751(1987).

The flow fields around moderately steep hills of triangular cross section and varying crosswind aspect ratio and around a bell-shaped hill were examined by using models immersed in a simulated neutral atmospheric boundary layer in a meteorological wind tunnel. The triangular hills ranged from an axisymmetric cone to a two-dimensional ridge. Concentration patterns resulting from sources of three heights placed upwind of each of these hills were examined to determine plume deformations and terrain-amplification factors.

28128 **(PB—88-160197/XAB) Ambient air audits of the National Crop Loss assessment Network (1981-1986).** Barnard, W.F.; Mahowald, N.M. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Jan 1988. 9p. (EPA—600/D-88/019). NTIS, PC A02/MF A01.

Since 1981 the Environmental Monitoring Systems Laboratory (EMSL) of the Environmental Protection Agency (EPA) at Research Triangle Park, North Carolina has been conducting performance audits of the ambient air analyzers used in the National Crop Loss Assessment Network (NCLAN). These audits provided the NCLAN researchers the means to assess the quality of the data gathered by their respective air-monitoring projects. The paper summarizes and reviews the results for all the audits from July 1981 through August 1986. Approximately 288 analyzers were audited and only 9 were found to be outside the NCLAN's acceptable goal of + or - 15%. Approximately 185 ozone, 81 sulfur dioxide, 18 oxides of nitrogen, and 4 carbon dioxide monitors were audited.

28129 **(PB—88-160296/XAB) Hepatic metabolism of the environmental mutagen 2-nitrofluoranthene.** Ball, L.M.; Nishioka, M.G.; Lewtas, J. (North Carolina Univ., Chapel Hill (USA). Dept. of Environmental Sciences and Engineering). Jan 1988. 15p. NTIS, PC A03/MF A01.

2-Nitrofluoranthene has recently been demonstrated to be the most abundant nitrated fluoranthene in organic extracts of ambient air particulate matter collected both in Philadelphia (Nishioka et al., unpublished results) and in Southern California. Whereas the better-known isomer 3-nitrofluoranthene (3-NFA) is found in combustion emissions such as diesel exhaust (2) and arises from direct nitration by NO_3/N_2O_4 or the NO(+2), 2-NFA appears to be formed from fluoranthene in the ambient air by a specific atmospheric transformation mechanism, possibly initiated by addition of an OH radical at the site of highest electron density. An analogous pathway would lead to the formation of 2-nitropyrene which was observed in rural ambient air particulate matter in Denmark. Other nitrated polycyclic aromatic hydrocarbons (nitroPAH) present in the environment are known to be potent bacterial mutagens. Their genotoxicity in prokaryotes is largely due to generation of active electrophiles (leading to formation of covalenty-bound C8-deoxyguanosine DNA adducts) by nitroreduction.

28130 **(PB—88-160536/XAB) Potential use of immunological markers in determining susceptible individuals to inhaled pollutants.** Koren, H.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Jan 1988. 36p. (EPA—600/D-88/017). NTIS, PC A03/MF A01.

Discussion in this review focuses on immunological markers of susceptibility to environmental pollutants. Since very little is known about this particular area, parts of the review will be of a speculative nature. The term immune system will be used in its broad sense to cover the specific and nonspecific cellular and humoral elements of the immune system as well as the cells and the mediators of the inflammatory and allergic responses. The major focus is on the pulmonary immune system.

28131 **(PB—88-160544/XAB) Application of matrix-isolation infrared spectroscopy to analysis for polynuclear aromatic hydrocarbons in environmental samples.** Wilson, N.K.; Childers, J.W.; Barbour, R.K. (Northrop Services, Inc., Research Triangle Park, NC (USA)). Jan 1988. 20p. NTIS, PC A03/MF A01.

Gas chromatography combined with matrix-isolation infrared spectroscopy (GC/MI-IR) enables identification and quantification of components of complex mixtures by infrared spectroscopy at levels of a few nanograms. These levels are several orders of magnitude lower than those achieved by light-pipe-based infrared measurements. Researchers used GC/MI-IR to identify polynuclear aromatic hydrocarbons in extracts of several types of air samples, including ambient-air particulate matter, diesel engine exhaust, and wood smoke. Included are examples of these analyses and a discussion of the on-going research using MI-IR for identification of unknown compounds associated with the highly mutagenic fractions of air samples.

28132 **(PB—88-160593/XAB) Wood-smoke-impacted air: mutagenicity and chemical analysis of ambient air from residential areas.** Watts, R.R.; Drago, R.J.; Merrill, R.G.; Williams, R.W.; Perry, E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Jan 1988. 14p. (EPA—600/D-88/021). NTIS, PC A03/MF A01.

An ambient-air sampling program was conducted in a wood-smoke-impacted residential area of Junea, Alaska during the winter of 1985-86. The study was undertaken to determine the bacterial mutagenicity (Ames test) and chemical characteristics of respirable particulate matter collected in the area. Fine-particle concentrations for the sampling period of November 16th to January 7th ranged from 1.19 to 209.8 micrograms per cu. m. Bioassay samples from ambient-air fine-particle concentration periods of 25.6 to 209.8 micrograms per cu. m. showed indirect acting mutagenicities of 6.64 to 77.8 rev./cu. m. with a mutagenicity/particle concentration correlation coefficient of 0.89. The indirect-acting mutagenic potency values ranged from 0.29 to 1.44 rev/micrograms of extracted organics and averaged 0.73 +/- 0.26.

28133 **(PB—88-160619/XAB) Technique for quantitative sensing of ozone. Phase 1 final report.** Parrish, A. (Millitech Corp., South Deerfield, MA (USA)). 1984. 38p. NTIS, PC A03/MF A01.

Researchers estimate, by means of numerical simulation, the capabilities of a millimeter-wave instrument to measure small changes in upper stratospheric ozone. When used at a dry, elevated site, it will detect a 1.2% ozone change in a 5-km altitude interval near 40-km altitude after 1 hour of observation. It will also detect a change in the altitude of the maximum mixing ratio by as little as 1 km. The altitude coverage is from 20 to 70 km. The rms noise on the recovered altitude data is 0.001 ppm after an observation of one-hour duration. The intensity measurements can be calibrated to an absolute accuracy of 5.5% or better.

28134 **(PB—88-160650/XAB) Evaluation of the performance of sulfation and nitration plates.** Sickles, J.E.; Michie, R.M. (Research Triangle Inst., Research Triangle Park, NC (USA)). 1987. 10p. NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 6, 1385-1391(Jun 1987).

Inexpensive, reliable, accurate means are needed to monitor SO_2 and NO_2 in the atmosphere. Sulfation and nitration plates have been used with varying degrees of acceptance for two decades. These devices are exposed for a period of time where the pollutant in the surrounding ambient air reacts with the reactive surface of the monitor. The monitor is then returned to the laboratory where a chemical determination of the reaction product is made. By considering the duration of exposure and the reactive surface area, a product flux is determined. The product flux is used along with a calibration factor (CF) to estimate the gas-phase concentration of the pollutant. Historically, the calibration factor, which relates ambient air pollutant concentration to product flux, has been assumed to be constant. The objectives of the study are to evaluate the performance of commercial sulfation and nitration plates. The study is designed to determine the sensitivity of plate-calibration factors to pollutant concentration, simulated wind speed, humidity, and temperature.

28135 **(PB—88-161146/XAB) Toxic Air Pollutant/ Source Crosswalk - a screening tool for locating possible sources emitting toxic air pollutants. Final report.** (Pacific Environmental Services, Inc., Durham, NC (USA)). Dec 1987. 313p. NTIS, PC A14/MF A01.

See also PB—86-238086.

This report presents an Air Toxic Pollutant Crosswalk that associates emitting-source categories with specific air-toxics compounds. This is a qualitative association and does not provide any information about the quantities of pollutants emitted from the source categories. The crosswalk contains pollutant names, CAS numbers, industrial source categories (SIC codes), and emitting source classifications (SCC codes). Appendices C-G of the EPA report, Compiling Air Toxics Emissions Inventory, EPA-450/4-86-010, were updated and expanded to develop the report. In addition, a software system containing the crosswalk was developed for easy access and updating of the data. Use of the system is explained in the EPA report, Toxic Air Pollutant/Source Crosswalk - Information Storage and Retrieval System User's Manual, EPA-450/4-87-023b. EPA is making available the system and data-base records to agency users upon request. The purpose of the report is to offer a technical service to air pollution control agencies in performing preliminary assessments of the types and sources of toxic compounds present in an area. The crosswalk helps agencies to identify the potential of pollutants to be emitted from sources in an area.

28136 **(PB—88-161542/XAB) National Performance Audit Program: ambient air audits of analytical proficiency, 1986.** Parr, B.F.; Lampe, R.L.; Pratt, G.; Dowler, O.L.; Mitchell, W.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Dec 1987. 58p. (EPA—600/4-87/038). NTIS, PC A04/MF A01.

See also PB—87-168076.

This report presents the results of the U.S. Environmental Protection Agency's 1986 National Audit Program by pollutant and by analytical method. Semiannual audits were conducted for Pb, NO_2 and SO_4 (filter strips) and acid rain, and annual audits were conducted for CO and high volume flow rate. Continuous SO_2 monitors were audited throughout the year, such that no monitor was audited more than once. Approximately 40 laboratories participated in each semiannual acid rain audit. Approximately 45 laboratories participated in each NO_2 and SO_4 audit and approximately 90 laboratories in each Pb audit. Two hundred and thirty-eight CO monitors, 246 SO_2 monitors and 1251 high-volume flow samplers were also audited. The results for each 1986 audit are presented in tabular form for each concentration level. The overall performance for all participants for each audit conducted since the beginning of the program is also illustrated in a series of figures.

28137 **(PB—88-161831/XAB) Nitric acid-nitrate aerosol measurements by a diffusion denuder: a performance evaluation.** Durham, J.L.; Spiller, L.L.; Ellestad, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 12p. (EPA—600/J-87/177). NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 3, 589-598(1987).

A nitric acid diffusion denuder made of nylon was operated in Riverside, CA, Houston, TX, and Claremont, CA. The pre-exponential and diffusion coefficients for the first term of the Gormley-Kennedy equation were estimated by regressing the log (mass deposited) against the axial distance from the entrance of the denuder. The field-study average values of the two coefficients were compared by the two-tail t-test to the average values for the HNO_3-air system determined in the laboratory; the test revealed that the means of the diffusion coefficients have probabilities less than or equal to 0.03 of being equal. The nitrate ion mass patterns in the denuder for the field cases do not adhere to the Gormley-Kennedy model applied to the simple HNO_3-air system. The source of excess nitrate deposited in the nylon tube could not be identified by the analysis. Candidate sources are deposition of gaseous N-compounds (analyzed as nitrate) other than nitric acid and evaporation of nitric acid from particles during transit in the denuder tube.

28138 **(PB—88-162094/XAB) Complex Terrain Dispersion Model (CTDM) terrain preprocessor system. User guide and program description. Final report.** Mills, M.; Paine, R.; Insley, E.; Egan, B. (Environmental Research and Technology, Inc., Concord, MA (USA)). Jan 1988. 177p. NTIS, PC A09/MF A01.

For system on diskette, see PB—88-161682 and PB—88-162169. See also PB—87-103586.

This report describes the theory and operation of a terrain preprocessor computer program which approximates actual terrain features with mathematical functions. The best-fit parameters for these functions are used by the Complex Terrain Dispersion Model (CTDM) in the calculation of lateral and vertical streamline displacement, an important step in the calculation of concentrations at hill receptor locations.

28139 **(PB—88-162102/XAB) User's guide to the CTDM (Complex Terrain Dispersion Model) meteorological preprocessor (METPRO) program. Final report.** Paine, R.J. (Notre Dame Univ., IN (USA). Dept. of Civil Engineering). Jan 1988. 161p. NTIS, PC A08/MF A01.

For system on diskette, see PB—88-161682 and PB—88-162169. See also PB—87-103586.

This User's Guide presents a review of the structure of the atmospheric boundary layer and its implications for the design of CTDM and its meteorological preprocessor (METRPO). The CTDM meteorological preprocessor calculates required meteorological variables that are derived from conventionally available data. These required variables include the Monin-Obukhov length, the surface friction velocity, the surface roughness length, and the mixed-layer height. The CTDM input data files contain these values as delivered by the meteorological preprocessor.

28140 **(PB—88-162110/XAB) EPA (Environmental Protection Agency) Complex Terrain Model Development. Final report.** Strimaitis, D.G.; Paine, R.J.; Egan, B.A.; Yamartino, R.J.; Greene, B. (Environmental Research and Technology, Inc., Concord, MA (USA)). Jan 1988. 485p. NTIS, PC A21/MF A01.

For system on diskette, see PB—88-161682 and PB—88-162169. See also PB—87-103586.

The Complex Terrain Model Development (CTDM) project has met its original objectives of producing an atmospheric dispersion model appropriate to elevated sources of air pollutants located in mountainous terrain settings under stable atmospheric conditions. The model development effort has focused on predicting concentrations during stable atmospheric conditions, which have generally been associated with the highest ground-surface values. The program, initiated in June 1980, has involved the performance of four major field experiments which produced data for model development and verification purposes, and a complete model. The CTDM, which has been developed and tested in the program, is an advanced Gaussian model that uses a flow algorithm that provides plume trajectories and deformation information. CTDM requires substantially more information on terrain and local meteorology than prior complex-terrain models. It can be used with simpler data bases, but demonstates degraded performance under these circumstances.

28141 **(PB—88-162128/XAB) User's guide to the Complex Terrain Dispersion Model. Volume 1. Model description and user instructions. Final report.** Paine, R.J.; Strimaitis, D.G.; Dennis, M.G.; Yamartino, R.J.; Mills, M.T. (Environmental Research and Technology, Inc., Concord, MA (USA)). Dec 1987. 173p. NTIS, PC A08/MF A01.

For system on diskette, see PB—88-161682 and PB—88-162169. See also PB—87-103586.

The Complex Terrain Dispersion Model (CTDM) is a refined air-quality model for use in complex-terrain applications. Its use of meteorological input data and terrain information is different than current EPA models; considerable detail for both types of input data are required and are supplied by preprocessors specifically designed for CTDM. CTDM requires the parameterization of individual hill shapes using the terrain preprocessor and the association of each model receptor with a particular hill. A central feature of CTDM is its use of a critical dividing-streamline height (Hc) to separate the flow in the vicinity of a hill into two separate layers; one of which flows over the hill, the other around it. The model will calculate on an hourly basis how the plume trajectory and shape are deformed by each hill. The computed concentration at each receptor is then derived from the receptor position on the hill and the resultant plume position and shape. The User's Guide describes the computer program, and gives instructions on its use.

28142 **(PB—88-162136/XAB) User's guide to the Complex Terrain Dispersion Model. Volume 2. Model code listings. Final report.** Paine, R.J.; Strimaitis, D.G.; Dennis, M.G.; Yamartino, R.J.; Mills, M.T. (Environmental Research and Technology, Inc., Concord, MA (USA)). Dec 1987. 266p. NTIS, PC A12/MF A01.

For system on diskette, see PB—88-161682 and PB—88-162169. See also PB—87-103586.

The Complex Terrain Dispersion Model (CTDM) is a refined air quality model for use in complex terrain applications. Its use of meteorological input data and terrain information is different than current EPA models; considerable detail for both types of input data are required and are supplied by preprocessors specifically designed for CTDM. CTDM requires the parameterization of individual hill shapes using the terrain preprocessor and the association of each model receptor with a particular hill. A central feature of CTDM is its use of a critical dividing-streamline height (Hc) to separate the flow in the vicinity of a hill into two separate layers; one of which flows over the hill, the other around it. The model will calculate on an hourly basis how the plume trajectory and shape are deformed by each hill. The computed concentration at each receptor is then derived from the receptor position on the hill and the resultant plume position and shape. The User's Guide describes the computer program, and gives instructions on its use.

28143 **(PB—88-162193/XAB) In-depth survey report: evaluation of brake-drum-service controls at United States Postal Service, vehicle maintenance facility, Nashville, Tennessee.** Godbey, F.W.; Cooper, T.C.; Sheehy, J.W.; O'Brien, D.M.; Van Wagenen, H.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 31p. (ECTB—152-20B). NTIS, PC A03/MF A01.

The effectiveness of a brake-washer assembly unit (Kleer-Flo Model LW-22 Rollabout) for limiting exposure to asbestos during the servicing of automotive brakes was evaluated as the U.S. Post Office Maintenance Garage in Nashville, TN. A fleet of 575 Jeep delivery vehicles are serviced at the facility. Most of the vehicles had 13- or 14-inch wheels and 10-inch long brake shoes. Ventilation in the garage was minimal. During winter months, there was no provision for fresh, heated air from the outside. When the 14 bay doors were open in the summer, they provided good ventilation in conjunction with roof fans. One gallon of concentrated detergent, Greasoff No. 19, was used diluted to clean 40 to 50 wheels. Very low asbestos exposures were recorded when the washing assembly was in operation. Personal air samples for the brake mechanics averaged less than the detection limit of 0.004 fibers/cubic centimeter (f/cc) with only one sample above 0.004f/cc. Of the ten vehicles tested, fibers found in the drums were between 83 to 100% chrysotile, with two vehicles having 100% asbestos fibers.

28144 **(PB—88-162201/XAB) In-depth survey report: control technology for asbestos removal at Sands Elementary School, Cincinnati, Ohio.** Hollett, B.A.; Caplan, P.E.; Cooper, T.C.; Froehlich, P.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 51p. (ECTB—147-19B). NTIS, PC A04/MF A01.

The effectiveness of the glove bag method for safely removing asbestos pipe lagging from the Sands Elementary School located in Cincinnati, Ohio, was investigated. Asbestos-fiber concentrations rose from a pre-removal level of 0.001 fibers per cubic centimeter (f/cc) to 0.010 f/cc during preparation of the pipe lagging for removal and 0.528f/cc during actual removal in glove bags. Workers used respiratory protection and were probably protected from excessive amounts of asbestos. After work was completed, a comparison of aggressive and nonaggressive sampling was made. Of 12 samples taken by the nonaggressive method, all were below the 10,000 fibers per cubic meter (f/m^3) Environmental Protection Agency criterion. All of six post-removal samples taken in the lunchroom by the aggressive method were above the 10,000f/m^3 limit. Good work practices observed included premisting lagging with amended water, wrapping pipe with plastic prior to starting removal work, use of a properly designed bag, starting with a clean empty bag at pipe interfaces, making cuts on preformed lagging blocks at joints to minimize fiber generation, using long hoses on amended water sprayers to optimize wetting practices, frequent spraying, use of high-efficiency particulate air vacuum to contain fibers and assist in collapsing the glove bag during removal, and removal of contaminated tools in an inverted glove for transfer to the next glove bag.

28145 **(PB—88-162243/XAB) Health-hazard evaluation report HETA 87-060-1825, Colorado State University, Fort Collins, Colorado.** Gunter, B.J.; Daniels, W.J.; Hales, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 15p. (HETA—87-060-1825). NTIS, PC A03/MF A01.

In response to a request from the Director, Environmental Health Services, Colorado State University, Fort Collins, an evaluation was made of chemical exposures in the veterinary histopathology laboratory at the university. Tissue-fixing and histology laboratories were involved. Analyses were made of general-room air samples and breathing zone samples for toluene, xylene, acetone, and ethanol. Two of six samples analyzed contained toluene at 1.8 and 0.6mg/cu m. Four samples contained xylene: 1.6, 1.8, 2.0, and 3.9mg/cu m. No acetone was detected in any sample. All samples contained ethanol ranging from 1.8 to 35.7mg/cu m. Medical studies of histopathology technicians and employees in the laboratories indicated no evidence of work related injury or illness. All exposure levels were significantly below NIOSH evaluation criteria (toluene 375mg/cu m, xylene 435mg/cu m, acetone 590mg/cu m, and

ethanol 1900mg/cu m, time weighted averages). Review of exhaust laboratory hoods and work stations hood indicated that improvements in the area were needed. The authors recommend adjustments to intake air handlers so that each laboratory would have an adequate make-up air volume to compensate for exhausted air. Biological monitoring of employees is recommended in order to estimate solvent exposures.

28146 **(PB—88-162250/XAB) In-depth survey report: control technology for asbestos removal at Winton Place Elementary School, Cincinnati, Ohio.** Hollett, B.A.; Caplan, P.E.; Cooper, T.C.; Froehlich, P.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 52p. (ECTB—147-19D). NTIS, PC A04/MF A01.

The efficiency of the glove-bag method to limit exposure to asbestos during removal of asbestos pipe lagging from the Winton Place Elementary School in Cincinnati, Ohio, was evaluated. Personal breathing-zone samples were collected during the work and found to be significantly below the 2,000,000 fibers per cubic meter (f/m^3) Occupational Safety and Health Administration standard in effect. Several sequential personal samples were taken. During removal operations, one sample was 200,000 fibers per cubic centimeter, whereas the other 13 were well under half of this. Several recommended practices used are presented, including premisting of all lagging with amended water, wrapping all pipe with plastic prior to the start of removal, use of only properly designed bags for the task including ones specially designed for working around large valves or fittings, starting with a clean empty bag at pipe interfaces with walls and ceilings, making cuts on preformed lagging blocks at the joints to minimize fiber generation, use of long hoses on amended water sprayers to optimize wetting practices, use of a high-efficiency particulate air-filter vacuum to contain fibers and collapse the glove bag during bag removal, and removal of contaminated tools in an inverted glove for transfer to the next glove bag. In general, the method proved useful in reducing worker exposure during asbestos-removal operations. Other recommended work practices are cited.

28147 **(PB—88-162268/XAB) In-depth survey report: evaluation of brake-drum service controls at Cincinnati Bell Maintenance Facility, Fairfax, Ohio.** Sheehy, J.W.; Todd, W.F.; Cooper, T.C.; Van Wagenen, H.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1987. 30p. (ECTB—152-21B). NTIS, PC A03/MF A01.

The effectiveness of vacuum units (Nilfisk Asbestos-Clene System) equipped with high efficiency particulate air filters in limiting exposure to asbestos during the servicing of automotive brakes was evaluated. Brake servicing of seven vehicles at the Cincinnati Bell Fairfax Garage was studied. Phase contrast microscope (PCM) analyses of personal air samples, collected for the duration of a single brake job or for 2 hours, whichever was longer, yielded counts ranging from 0.004 fiber per cubic centimeter (f/cc) (detection limit) to 0.016f/cc using an aspect ratio of 5:1. Effective control was evidenced by the low exposures for the brake mechanics; 79% of the air samples, including personal, axle, fender, background, and ambient samples were below detectable limits. Transmission electron microscopy also showed very low asbestos concentrations. The authors caution that workers should not use a dry cloth to clean hands after finishing a brake job. Instructions are offered for safe removal and replacement of the various filters in vacuum units.

28148 **(PB—88-162276/XAB) Emission characteristics of the evaporative pattern-casting process.** Gressel, M.G.; O'Brien, D.M.; Tenaglia, R.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 20 Jan 1987. 51p. (ECTB—161-04). NTIS, PC A04/MF A01.

An attempt was made to identify contaminants produced, to quantify major contaminants, and to determine the temporal nature of these emissions during vaporization of low-density polystyrene foam used in the pattern-casting process. A sampling hood was used to obtain emissions, which were analyzed for aerosols and specific contaminants. Major gaseous contaminants identified were styrene, benzene, toluene, and ethyl-benzene. The evaporative pattern-casting (EPC) molds produced more carbon soot and hydrocarbons during pouring than the green sand, for both iron and aluminum castings. Carbon monoxide concentrations were extremely high during pouring and casting removal of the iron castings made with green sand while concentrations with EPC were significantly lower. With either process, carbon monoxide levels produced during production of aluminum castings were not significant. Benzene was a significant hazard during both pouring and shakeout of iron castings made using the EPC process.

28149 **(PB—88-162649/XAB) Health-hazard evaluation report HETA 84-477-1824, Bunge Corporation, Decatur, Alabama.** Arnold, S.; Crandall, M.S.; Smith, A.B. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 46p. (HETA—84-477-1824). NTIS, PC A03/MF A01.

In response to a request from the Oil, Chemical and Atomic Workers Union Local 3-906, an evaluation was made of symptoms of respiratory irritation and skin rashes in employees at the Bunge Corporation located in Decatur, Alabama. These employees were exposed to soybean dusts as raw dust, cleaner dust, extracted dust, or mixed dust. For 34 workers, the range of total raw dust exposure was 0.16 to 22.6mg/m3. One employee performing a cleanup operation in the head house was exposed to nuisance dust at 14.7mg/m3, near the Occupational Safety and Health Administration permissible exposure limit of 15mg/m3. Another worker was exposed to 22.6mg/m3 during a similar operation. At the time of study, use of personal respiratory protective equipment was by worker discretion. For workers exposed to raw dust, respirable dust ranged from 0.02 to 1.02mg/m3, with employees in the beanbarge cleanup area and head house utility workers having the highest exposures. Exposures to cleaner soybean dust ranged from 0.18 to 0.72mg/m3. A high prevalence of lower respiratory symptoms was found, correlating with dust exposure, particularly raw soybean dust. Occupational asthma could not be confirmed or ruled out.

28150 **(PB—88-162656/XAB) Health hazard evaluation report HETA 85-308-1829, Kardon Industries, St. Paris, Ohio.** Zey, J.N.; Todd, W.F. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1987. 21p. (HETA—85-308-1829). NTIS, PC A03/MF A01.

In response to a request by the factory manager and United Paperworkers Union local 1467 to investigate employee complaints of headaches and eye and throat irritation associated with operation of hand and automatic wax lines, an evaluation was made at Kardon Industries Composite Can and Tube Division, St. Paris, Ohio. The study focused on an amorphous polypropylene wax used on wax lines along with air samples for organic vapors, aldehydes, ketones, carbon monoxide, and carbon dioxide. Relatively low levels of several hydrocarbons were found, with n-hexane present in highest concentrations relative to occupational hygiene criteria, being measured at 28.7mg/m3. While no furfural was detected, all samples contained formaldehyde and acetaldehyde. Both aldehydes were also detected as decomposition products of the wax. The supplier of the wax stated that it gave off ketones, aldehydes, and eventually carboxylic acids when it was heated. Employees reported symptoms of headache, burning eyes, throat and nose irritation, dizziness, and an altered sense of taste and nausea. Aldehydes were considered to be the causative agents of these conditions.

28151 **(PB—88-162664/XAB) Health-hazard evaluation report MHETA 85-226-1839, Freshlabs, Inc., Warren, Michigan.** Sanderson, W.T.; Ferguson, R.P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 56p. (MHETA—85-226-1839). NTIS, PC A04/MF A01.

In response to a request from workers at the Freshlabs vitamin manufacturing facility located in Warren, Michigan, a study was made of dust exposures, with specific attention to asbestos in ceiling insulation. Over half of all workers (about 70) reported watery itchy eyes, sneezing, or runny stuff noses. Symptoms of skin rashes, cough, chest tightness, and shortness of breath were also reported throughout the facility. Dust concentrations were highest in the composition area, where all workers experienced irritation of eyes, nose, and throat, and a few developed occupational asthma confirmed by company physicians. Workers were exposed to sever-

al vitamin products which were irritating to eyes and nasal and respiratory mucosa because of acidity. Some workers became hypersensitive to dusts due to protein and polysaccharide contents. Most samples showed total and respirable dust measurements well below Occupational Safety and Health Administration permissible exposure limits for nuisance dusts. However, these are not common nuisance dust components. The authors suggest that the limits provide little protection for average workers exposed to such dusts. Asbestos sampling revealed potential hazard from falling insulation. Recommendations pertaining to local exhaust hoods, amended work practices, use of personal dust respirators, avoidance of skin contact, and proper ceiling insulation are offered.

28152 (PB—88-162672/XAB) Health-hazard evaluation report HETA 85-003-1834, B.F. Goodrich, Woodburn, Indiana. London, M.A.; Lee, S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1987. 27p. (HETA—85-003-1834). NTIS, PC A03/MF A01.

In response to a request from the United Rubber, Cork, Linoleum and Plastic Workers of America Local 715, an investigation was made of an apparent excess of cancers appearing among workers in the B.F. Goodrich tire manufacturing facility located in Woodburn, Indiana. Excesses were reported in the milling and tuber areas of the facility. Company medical records, death certificates, and medical records from private physicians or hospitals were used to obtain data. Five cases of lung cancer and one of leukemia were confirmed. Analysis revealed a ten-fold increase in lung-cancer incidence over the expected number. In a survey made 5 years previously, breathing-zone samples were taken for nitrosamines, for which NIOSH recommends keeping exposure as low as possible. Exposures to N-nitrosomorpholine ranged from 0.5 to 1.8 micrograms per cubic meter (microg/m^3) and exposures to N-nitrosodimethylamine ranged up to 0.09microg/m^3. Exposures to benzene in 1975 ranged from 0.5 to 11.9 parts per million. Measurements taken since 1980 showed significantly lower levels. Also, prior to 1979, talc was used at the facility, suggesting possible exposure to asbestos.

28153 (PB—88-162698/XAB) Health-hazard evaluation report MHETA 86-191-1836, West Virginia Department of Highways, Charleston, West Virginia. Kullman, G.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1987. 25p. (MHETA—86-191-1836). NTIS, PC A03/MF A01.

In response to a request from the West Virginia Department of Highways, an evaluation was performed at its Sign Shop in Charleston, West Virginia, for possible exposures to solvent vapors from silkscreening and exposures to excessive noise from sign fabrication. Levels of organic vapors and dibutyl phthalate (less than 0.02mg/cu. m) during silkscreening were well below existing standards for exposure levels; however, there were some working conditions in this area that could cause discomfort among workers under varying conditions. The general exhaust fan did not run continuously during operations, no mechanical-supply air source for area general exhaust fans was provided, poor placement of signs while drying caused vapors to be drawn past workers at breathing-zone levels thus increasing their exposure potential, and no protective goggles or gloves were used routinely when handling solvents and inks. Recommendations addressing each of these shortcomings are presented. It is also recommended that workers in sign fabrication wear hearing-protection devices when using shop equipment or when working in an area where such equipment is being used.

28154 (PB—88-162706/XAB) Health-hazard evaluation report HETA 86-472-1832, commercial office buildings, Boston, Massachusetts. Kominsky, J.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1987. 47p. (HETA—86-472-1832). NTIS, PC A03/MF A01.

Surface and air contamination by polychlorinated biphenyls (PCBs) polychlorinated dibenzofurans (PCDFs), and polychlorinated dibenzo-p-dioxins (PCDDs) were studied in two office buildings in Boston to obtain background levels for comparison with cleanup guidelines for another building, the 50 Staniford Street Office Building, which had experienced a transformer fire in 1981. Charles River Park Properties requested the study. Concentrations of PCBs on workspace surfaces ranged from less than 1 to 69 micrograms/square meter (microg/m2) and less than 1 to 100microg/m2. Concentrations of PCDFs on work surfaces ranged from 0.48 to 5.4 nanograms per square meter (ng/m2), and PCDD concentrations from 2.8 to 146ng/m2. Concentrations of PCBs in workspace air samples ranged from 0.06 to 0.31 micrograms per cubic meter. Airborne PCDFs were undetected except for hepta and octa isomers. PCBs were significantly correlated with PCDDs and PCDFs in terms of surface concentrations.

28155 (PB—88-162714/XAB) Health-hazard evaluation report MHETA 87-040-1838, Freeman United Coal Mining, Frankfort, Illinois. Cornwell, R.; Stark, G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 13p. (MHETA—87-040-1838). NTIS, PC A03/MF A01.

In response to a request from the United Mine Workers of America, Deputy Administrator of Occupational Health, a study was made of worker exposure to a resin used in the roof bolting operation at the Freeman United Coal Company Mine No. 6, located in Frankfort, Illinois. One worker developed a severe asthma attack following initial exposure to the resin, Du-Pont FASLOC, and was diagnosed by two pulmonary medicine specialists as having occupationally induced asthma. Sensitization to the resin or its components was not tested. Three other workers reported headaches, sore throats, and coughs following exposure. All four were interviewed, and medical histories were requested but only one was obtained. Air samples were taken near machine operators' breathing zones and downwind of vapors during roof bolting. These were analyzed for resin components, styrene, vinyl-toluene, or butyl benzyl phthalate. There were no detectable levels of the latter two chemicals, and styrene was present near the detection limit of 0.05 parts per million. The authors conclude that there is no health risk to the general work force from this resin. However, if a true hypersensitivity does exist in the asthmatic individual, further resin exposure would be harmful to the worker.

28156 (PB—88-162722/XAB) Health-hazard evaluation report HETA 87-166-1835, US Post Office Building, Oklahoma City, Oklahoma. Kominsky, J.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1987. 31p. (HETA—87-166-1835). NTIS, PC A03/MF A01.

In response to a request from the U.S. Department of Justice on behalf of the U.S. Postal Service, a study was made of background concentrations of polychlorinated biphenyls (PCBs) in the Post Office Building located in Oklahoma City, Oklahoma. The purpose of the study was to determine the concentration of PCBs in a building similar in structure to the Page Belcher Federal Building in Tulsa, Oklahoma, which had experienced a soot-producing electrical transformer malfunction in 1982. Nondetectable PCB levels were registered in 14 of 18 workspace air samples. Four of the 18 samples showed PCB concentrations ranging from 0.006 to 0.10 micrograms/cubic meter (microg/cu m). Of 37 samples collected in the Page Belcher Federal Building, all showed concentrations ranging from 0.11 to 0.37microg/cu m. Surface PCB concentrations in the Oklahoma City building air-supply diffusers ranged from nondetectable to 44 micrograms per square meter (microg/sq m), while those in the Page Belcher Building ranged from 2 to 332microg/sq m. The overall PCB concentrations on workspace surfaces throughout the two buildings did not differ significantly except in mail-handling workrooms.

28157 (PB—88-162763/XAB) Health-hazard evaluation report HETA 87-176-1826, St. James Community Hospital, Butte, Montana. Gunter, B.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 15p. (HETA—87-176-1826). NTIS, PC A03/MF A01.

In response to a request from the Director of Nursing Service at St. James Community Hospital located in Butte, Montana, an evaluation was made of exposures to glutaraldehyde in the respiratory therapy and sigmoidoscopy departments of the hospital, where it was used in equipment sterilization. Glutaraldehyde concentrations in three breathing-zone samples were 0.25mg/cu m, 0.38mg/cu m, and below the detection level. Of six general area samples, five showed measurable concentrations ranging from 0.48 to

0.209mg/cu m. The American Conference of Governmental Industrial Hygienists has set a threshold-limit value of 0.7mg/cu m ceiling value for glutaraldehyde. The author concludes that no health hazard exists for glutaraldehyde in these operations. Informal interviews of technicians in the two departments did not reveal any health problems that could be attributed to glutaraldehyde exposure. Respiratory therapy equipment was cleaned in a hallway used as a passageway for other personnel. It is recommended that an improved arrangement be devised for cleaning respiratory equipment and that the area used for the purpose not be used as a hallway. The author also recommends that the ventilation system for the sigmoidoscope disinfecting operations be shared with other facilities, as it was very effective.

28158 (PB—88-162771/XAB) Health-hazard evaluation report HETA 87-288-1828, Henry Ford High School, Detroit, Michigan. Crandall, M.S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 14p. (HETA—87-288-1828). NTIS, PC A03/MF A01.

In response to a request from teachers in the Henry Ford High School (SIC-8211) located in Detroit, Michigan, a study was made of possible malfunctions of polychlorinated biphenyl (PCB)-containing fluorescent-light ballasts which were suspected of being causally related to increased occurrences of respiratory symptoms, sore throats, and headaches. Surface wipe samples and air samples were analyzed in four classrooms where complaints had originated and in three reference rooms where no symptoms had been reported. No levels of PCB air concentrations were found exceeding 0.1 microgram/cubic meter (microg/m^3) in any reference room. In three of four index rooms, PCB concentrations were recorded at 0.2, 0.3, and 0.4 microg/m^3, which were below the NIOSH recommended exposure level (1microg/m3 time weighted average). Surface-wipe samples from student and teacher desk tops averaged 1.3 micrograms per square meter (microg/m^2), with a maximum of 2.4microg/m^2. On low contact surfaces, PCB concentrations ranged from 1.6 to 9.2microg/m^2.

28159 (PB—88-162789/XAB) Health-hazard evaluation report MHETA 87-039-1837, Old Ben Coal Company, Benton, Illinois. Cornwell, R.J.; Stark, G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 14p. (MHETA—87-039-1837). NTIS, PC A03/MF A01.

In response to a request from the Deputy Administrator, Occupational Health, of the United Mine Workers of America, a study was made of possible worker exposure to two hydraulic fluids at the Old Ben Coal Company located in Benton, Illinois. Employees using Solcenic-3A hydraulic fluid or working near its area of use had reported eye, skin, or respiratory irritation. Solcenic-2 fluid produced no symptoms. Chemical analysis revealed that Solcenic-3A contained dipropylene-glycol isomers and a small amount of ethanolamine which were not present in Solcenic-2. The authors suggest that these components may lower the Solcenic-3A odor threshold. Area air evaluations indicated no harmful exposures to the component methyl-isobutyl-carbinol, with exposures of 1.4 and 3.4mg/cu m determined for two of 11 samples. No excessive exposure to the component napthenic mineral oil was found; it was considered that workers were exposed to it only during hydraulic-line ruptures or fluid spills. Of 13 workers reporting symptoms, nine of 11 interviewed had symptoms possibly due to skin or inhalation exposure to Solcenic-3A. The authors suggest that inhalation symptoms are a reaction to its strong vapor. They conclude that there is no health hazard, but they recommend use of protective equipment, proper disposal of waste, and use of nonirritating Solcenic-2.

28160 (PB—88-163191/XAB) In-depth survey report: control technology for asbestos removal at Washburn Elementary School, Cincinnati, Ohio. Hollett, B.A.; Caplan, P.E.; Cooper, T.C.; Froehlich, P.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 50p. (ECTB—147-19A). NTIS, PC A03/MF A01.

The effectiveness of the glove-bag control method to prevent exposure to asbestos during removal of asbestos pipe lagging from the Washburn Elementary School in Cincinnati, Ohio, was evaluated. During the work, the method appeared to function well in controlling worker exposures to asbestos fibers. It is recommended that workers use respiratory protection on any glove-bag work due to possible leakage. During removal operations, asbestos fiber concentrations rose from a preremoval level of 0.002 fibers per cubic centimeter (f/cc) to 0.020f/cc during preparation of pipe lagging for removal and to 0.289f/cc during actual removal in glove bags. These workers had limited experience with the glove-bag technique; the authors suggest that this is common for individuals required to use the method. The authors conclude that a secondary containment system should be used as an adjunct to the glove-bag treatment, such as negative air barriers.

28161 (PB—88-163761/XAB) PCDD (polychlorinated dibenzo-para-dioxins) and PCDF (polychlorinated dibenzofurans) emissions from incinerators for municipal sewage sludge and solid waste - evaluation of human exposure. (World Health Organization, Copenhagen (Denmark). Regional Office for Europe). 1987. 66p. (EH—17). NTIS, PC A04/MF A01.

Report on a WHO meeting, Naples (Italy), March 17-21, 1986.

The meeting reviewed and discussed the available emission data and public-health aspects related to the emission of PCDDs and related compounds during incineration of municipal sewage sludge and municipal solid waste. The meeting provided national and local health authorities with advice on the public-health significance of these emissions and pointed out practicable approaches to minimize them.

28162 (PB—88-164140/XAB) Analysis of meteorological conditions and haze distribution for the second Arctic Gas and Aerosol Sampling Program (AGASP II), March-April 1986. Technical memo. Herbert, G.A.; Bridgman, H.A.; Schnell, R.C.; Bodhaine, B.A.; Oltmans, S.J. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Nov 1987. 74p. (NOAA-TM-ERL-ARL—158). NTIS, PC A04/MF A01.

The second Arctic Gas and Aerosol Sampling Program (AGASP II) was conducted across the non-Soviet Arctic in March and April 1986, to study the aerosol, chemical, and optical properties of Arctic haze. One component of the program was conducted with a specially instrumented NOAA WP-3D aircraft. Measurements of wind, pressure, temperature, ozone, water vapor, condensation-nuclei concentration, and aerosol-scattering extinction were used to determine the locations of significant haze layers. The first three NOAA WP-3D research flights were conducted north of Pt. Barrow, Alaska, and over the Beaufort Sea northeast of Barter Island, Alaska. The following three sampled conditions in the high Arctic near Alert, Northwest Territories, Canada.

28163 (PB—88-165287/XAB) Corrections for differential scattering by aerosols in the measurement of ozone by DIAL (Differential Absorption Lidar). Milton, M.J.T. (National Physical Lab., Teddington (UK). Div. of Quantum Metrology). 1987. 22p. (NPL-QU—78). NTIS, PC E03/MF E03.

The DIAL technique is commonly used for measuring ozone in the troposphere. This report presents a method for calculating the systematic error in such measurements due to aerosol differential absorption and backscatter.

28164 (PB—88-165683/XAB) Selection guide for volatilization technologies for water treatment. Final report, February 1984-June 1984. Fleming, J.L. (IT Corp., Knoxville, TN (USA)). Feb 1988. 130p. NTIS, PC A07/MF A01.

This guide presents a methodology for evaluating applicability of volatilization technologies for removing volatile organics from water. The volatilization technologies assessed in the study include: surface sprayers, surface aerators, bubble columns, cooling towers, steam strippers, unaided evaporation from an impoundment, spray columns, and packed air stripping columns. The guide enables users to assess performance and cost under a variety operating conditions (e.g., temperature, influent concentration, allowable liquid and gas-effluent concentration, and flow rates) for representative equipment designs that could be transported on a trailer 2.4 m wide, 13.7 m long, with a maximum height of 4.1 m. The designs are used as a basis to calculate representative contaminant-removal

efficiency, treatment rates, air emissions, and treatment costs of each technology. A key parameter used in assessing these technologies is the Henry's Law constant (H). A tabulation of available values of H is provided for volatiles designated as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Methods for estimating H are also described. Qualitative guidance is provided on other factors that should be considered during site-specific assessments of the technical and economic feasibility of volatilization technologies. Offgas treatment is not described. An example problem is solved to demonstrate the methodology.

28165 (PB—88-167481/XAB) Rocky Mountain acid-deposition model assessment: evaluation of mesoscale acid deposition models for use in complex terrain. Morris, R.E.; Kessler, R.C.; Douglas, S.G.; Styles, K.R. (Systems Applications, Inc., San Rafael, CA (USA)). Feb 1988. 241p. NTIS, PC A11/MF A01.

See also PB—87-180584; Portions of this document are not fully legible.

This report includes an evaluation of candidate meteorological models and acid-deposition models. The hybrid acid-deposition/air-quality modeling system for the Rocky Mountains makes use of a mesoscale meteorological model, which includes a new diagnostic wind model, as a driver for a Lagrangian puff model that treats transport, dispersion, chemical transformation, and dry and wet deposition. Transport is defined from the diagnostic wind model based on the wind at the puff center. The treatment of dispersion is based on the parameterization in the PNL/MELSAR-POLUT, while retraining the MESOPUFF-II dispersion algorithms as an option. Based on the evaluation of the chemical mechanisms, the RIVAD chemistry appears to be the most scientifically sound, as well as consistent, with the Lagrangian puff model formulation. Dry deposition uses the CCADM dry-deposition module with some minor adjustments. Wet deposition is based on the scavenging coefficient approach as used in the ERT/MESOPUFF-II.

28166 (PB—88-167655/XAB) Understanding CO_2 and climate. Annual report 1986. Hegeveld, H.G. (Atmospheric Environment Service, Downsview, Ontario (Canada)). Aug 1987. 30p. NTIS, PC E03/MF A01.

This report provides a general overview of these activities, as highlighted in the following: (1) Evidence of the effects of human society and its activities on the earth's atmosphere continues to accumulate; (2) Changes in atmospheric composition are expected to cause major alterations to the earth's climate; (3) The effects on society of higher CO_2 concentrations, warmer global climates, and related changes are complex and difficult to assess. Some humans will benefit, others will suffer. Ongoing studies into how natural ecosystems, and hence how humans, are likely to react to global change are gradually adding to the knowledge base required by policy makers for appropriate response; (4) The effects of human activities on the planet's atmospheric life-support system and the implications of related changes for humans are emerging as major international policy issues. Yet the understanding of the problem is still very limited and subject to controversy, and hence becomes a major obstacle to timely and responsible policy action.

28167 (PB—88-168463/XAB) Progress in the prevention and control of air pollution in 1986. Annual report (Final). (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jan 1988. 106p. (EPA—450/2-88/001). NTIS, PC A06/MF A01.

See also report for 1985, PB—87-156691.

The report addresses the progress made in the prevention and control of air pollution in 1986. It covers the areas of air-quality trends and monitoring, developing of air-quality criteria and standards, the status of State implementation plans, the control of stationary and mobile source emissions, enforcement, and litigation. The report is the annual report of the Administrator of EPA to the Congress in compliance with Sections 313, 202(b)(4), and 306 of the Clean Air Act, as amended.

28168 (PB—88-168471/XAB) Health-hazard evaluation report HETA 86-434-1833, Federal Office Building, Evansville, Indiana. Bryant, C.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1987. 19p. (HETA—86-434-1833). NTIS, PC A03/MF A01.

An evaluation was made of potential asbestos exposure in the Federal Office Building located in Evansville, Indiana. Several surface samples revealed chrysotile and amosite fibers which indicated a history of past airborne asbestos at the site. The author concluded that a potential health hazard exists. It is recommended that the material be safely removed by a reliable contractor skilled in asbestos abatement. Interim precautionary measures are suggested to allow for building use until the asbestos is completely removed.

28169 (PB—88-168992/XAB) Assessment of SO_2 and NOx emission control technology in Europe. Final report, April 1986-March 1987. Ellison, W. (Ellison Consultants, Monrovia, MD (USA)). Feb 1988. 88p. NTIS, PC A05/MF A01.

The report is a compilation of information on the current status of abatement technology used to control major air pollutants, including SO_2 and NOx, in Europe. It focuses on flue-gas sulfurization (FGD), combustion modification (CM), and selective catalytic reduction (SCR) of NOx. Information presented was gathered from utility company representatives and FGD, CM, and SCR process developers, as well as from the author's research. Current air-pollution regulations in Europe, related problems, operational parameters of commercial FGD and SCR plants, FGD and SCR economics, and the author's evaluation of the processes are also described.

28170 (PB—88-169388/XAB) National air-pollutant-emission estimates, 1940-1986. Final report. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jan 1988. 80p. (EPA—450/4-87/024). NTIS, PC A05/MF A01.

Supersedes PB—87-181236.

The report presents estimates of trends in nationwide air-pollutant emissions for the six major pollutants: sulfur oxides; particulates; carbon monoxide; volatile organic compounds; nitrogen oxides; and, lead. Estimates are broken down according to major types of air-pollutant sources. A short analysis of emission trends is given, along with a discussion of methods used to develop the data.

28171 (PB—88-169487/XAB) UNAMAP: user's network for applied modeling of air pollution, VERSION 6 (revised). Model simulation. Turner, D.B.; Bender, L.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). 4 Jan 1988. mag tap. NTIS CP T99.

Supersedes PB—86-222361; Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes 41 related documents.

UNAMAP (VERSION 6) Dated 4 Jan 88 represents the update to the Users Network for Applied Modeling of Air pollution. UNAMAP consists of an ASCII magnetic tape containing FORTRAN codes and test data for 24 Air Quality Simulation Models (AQSM) as well as associated documentation. AQSM's and supporting programs and data are arranged in seven sections: Section 1. Guideline (Appendix A) models..(file 2 through 9); Section 2. Other models or processors (New models)..(files 10 through 19 and 33); Section 3. Other models and processors (revised)..(files 20 through 27 and 32); Section 4. Additional models for regulatory use (files 28 through 31); Section 5. Added models..(file 69); Section 6. Data files..(files 34 through 39); Section 7. Output print files..(files 40 through 68 & 70). There are 70 files on the tape.

28172 (PB—88-170576/XAB) Calcium hydroxide and calcium carbonate particle-size effects on reactivity with sulfur dioxide. Gullett, B.K.; Blom, J.A. (Acurex Corp., Research Triangle Park, NC (USA)). 1987. 17p. NTIS, PC A03/MF A01.

Pub. in Reactivity of Solids 3, 337-350(1987).

This paper reports results of measurements of the effect of in-situ calcium-based sorbent particle size upon reactivity with 3000 ppm SO_2 in an 1100-C drop-tube furnace, using on-line collection of the reacted sorbent with a particle cascade impactor. Significant agglomeration occurred for $Ca(OH)_2$, while little was apparent for $CaCO_3$. Reactivity of all sorbent particles increases as the measured particle diameter decreases, such that conversion is inversely related to diameter to the 0.22 to 0.32 power. For these sorbents, $Ca(OH)_2$ particles had greater reactivity than the similarly sized $CaCO_3$ sorbent.

28173 (PB—88-170626/XAB) Mutagenicity of teflon-coated glass-fiber filters: a potential problem and solutions. Houk, V.S.; Zweidinger, R.B.; Claxton, L.D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 6p. (EPA—600/J-87/213). NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 21, No. 9, 917-920(Sep 1987).

Teflon-coated glass-fiber filters, used in studies of airborne particulate matter, were tested for mutagenic activity using the Salmonella/mammalian-microsome (Ames) assay. For each sample, eight blank filters were simultaneously extracted with dichloromethane (DCM), and the extract was concentrated by rotary evaporation and a nitrogen purge. Samples were solvent exchanged into dimethylsulfoxide (DMSO) for bioassay. Mutagenicity testing was performed using tester strain TA98, with and without metabolic activation. Preliminary findings have indicated that both direct- and indirect-extracting frameshift mutagens were present on the blank filters. Pre-extracting the filters with DCM reduced the activity associated with the filters; however, forced-air baking enhanced the mutagenic response. Additional analyses have suggested that the interference caused by filter mutagenic is inversely proportional to extraction efficiency and particle load.

28174 (PB—88-171780/XAB) Inventory of acid-rain investigations in the Netherlands. Clason, R.F.; de Lavieter, L. (Studie- en Informatiecentrum TNO voor Milieu-Onderzoek, Delft (Netherlands)). Jan 1986. 142p. (In Dutch). NTIS, PC E06/MF A01.

28175 (PB—88-859053/XAB) Electrostatic precipitators. January 1979-February 1988 (Citations from the NTIS data base). Report for January 1979-February 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 155p. NTIS PC N01/MF N01.

Supersedes PB—84-877349.

This bibliography contains citations concerning the utilization of electrostatic precipitators for air-pollution control in industrial plants and electrical-power-generating facilities. Topics include theoretical analyses, field investigations of specific installations, and performance comparisons with other particulate-removal systems. Economic evaluations and system design considerations are presented. (This updated bibliography contains 306 citations, 37 of which are new entries to the previous edition.)

28176 (PB—88-859178/XAB) Air pollution tracer studies in the lower atmosphere. May 1985-February 1987 (Citations from the NTIS data base). Report for May 1982-February 1987. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 65p. NTIS PC N01/MF N01.

Supersedes PB—86-863800.

This bibliography contains citations concerning the utilization of a variety of tracers to study lower-atmospheric air-pollution movements. Project descriptions and results, and techniques and materials used are among the topics considered. Tracer movement from nuclear power plants, industrial stacks, and urban areas is discussed. (This updated bibliography contains 111 citations, 46 of which are new entries to the previous edition.)

28177 (PB—88-859467/XAB) Volatile organic compounds in coatings. January 1980-February 1988 (Citations from World Surface Coatings Abstracts). Report for January 1980-February 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 74p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the production of coatings that meet regulations set to reduce volatile organic compounds (VOC). Environmental Protection Agency regulations and coating compositions designed to meet those regualtions are discussed. Citations of selected patents are included. Applications in automotive coatings, appliance paints, and printing inks are presented. (Contains 187 citations fully indexed and including a title list.)

28178 (PB—88-860853/XAB) Atmospheric modeling of air pollution. September 1984-March 1988 (Citations from the NTIS data base). Report for September 1984-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 177p. NTIS PC N01/MF N01.

Supersedes PB—87-853974.

This bibliography contains citations concerning the development, validation, and application of mathematical models for air-pollution studies of mobile and stationary pollution sources. The models cover a wide range of mathematical complexity, utilizing factors such as terrain features, wake effects, diffusion, atmospheric stability, atmospheric wind, precipitation scavenging, gravitational deposition, atmospheric photochemistry, and urban heat islands. The models are used to support environmental impact studies and effects of proposed emission control strategies. Excluded are models of stratospheric pollution behavior, as applied to high flying aircraft. (This updated bibliography contains 352 citations, 104 of which are new entries to the previous edition.)

28179 Associations between 1980 US mortality rates and alternative measures of airborne particle concentration. Oezkaynak, H.; Thurston, G.D. (Harvard Univ., Cambridge, MA (USA)). *Risk Analysis;* 7: No. 4, 449-461(Dec 1987). Contract AC02-81EV10731.

The authors analyzed the 1980 US vital statistics and available ambient air pollution data bases for sulfates and fine, inhalable, and total suspended particles. Using multiple regression analyses, we conducted a cross-sectional analysis of the association between various particle measures and total mortality. Results from the various analyses indicated the importance of considering particle size, composition, and source information in modeling of particle pollution health effects. Of the independent mortality predictors considered, particle exposure measures related to the respirable and/or toxic fraction of the aerosols, such as fine particles and sulfates, were most consistently and significantly associated with the reported SMSA-specific total annual mortality rates. On the other hand, particle mass measures that included coarse particles (e.g., total suspended particles and inhalable particles) were often found to be nonsignificant predictors of total mortality. Furthermore, based on the application of fine particle source apportionment, particles from industrial sources (e.g., from iron/steel emissions) and from coal combustion were suggested to be more significant contributors to human mortality than soil-derived particles.

28180 Interlaboratory comparison of formaldehyde emissions from particleboard underlayment in small-scale environmental chambers. Matthews, T.G.; Wilson, D.L.; Thompson, A.J.; Mason, M.A.; Bailey, S.N.; Nelms, L.H. (Oak Ridge National Lab., TN (USA)). *Journal of the Air Pollution Control Association;* 37: No. 11, 1320-1326(Nov 1987).

Formaldehyde (CH_2O) emissions from particleboard underlayment have been measured in 0.17 and 0.2 m^3 chambers at separate laboratories to test the comparability of small scale environmental chamber measurements under different ventilation and product loading conditions. Absolute CH_2O calibration was established through intermethod comparison of different monitoring techniques against a CH_2O generation apparatus. Interlaboratory precision was enhanced via co-calibration of each laboratory's CH_2O colorimetric analyzer against the same blank and bi-level generation source at the beginning and end of the study. The results show excellent intermethod and interlaboratory agreement in both the CH_2O calibration and particleboard emissions testing. The CH_2O emission rates of the test specimens demonstrate a Fick's Law dependence on CH_2O vapor concentration. Measured CH_2O concentrations are described by a single-compartment, single emitter model, and are inversely proportional to the ratio [N/L (m/h)] of the air exchange rate [$N(h^{-1})$] and product loading [$L(m^{-1})$]. Comparison tests at varying N and L, but uniform N/L were performed; similar CH_2O

concentrations were measured for N and L levels selected from an indoor compartment model, and for fivefold larger N and L values, which are more convenient for small-scale chamber testing.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 27603

28181 (INPE—3633) Short half-life descendents from radon measured in Sao Jose dos Campos and Cachoeira Paulista, Brazil, and its correlation with meteorological data. Andrade Marinho, E.V. de. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Sep 1985. 121p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702392/JAW.

The correlations between the activity of the short half-life radon decay products in the low atmosphere and the meterological parameters, measuring the atmospheric polonium 214 are studied. The aerosols were collected on membrane filters and analysed by alpha spectrometry. Measurements have been made in Sao Jose dos Campos and Cachoeira Paulista, in Brazil. At S. Jose dos Campos the influence of the pluviometry on the concentration of atmospheric Po/sup 214/ has been analysed, showing that high activity correspond to low pluviometry and inversely, low activities correspond to high pluviometry. At Cachoeira Paulista, the variation in the atmospheric Po/sup 214/ activity in corresation with the air stability, measured, showing the accumulation of radioactive aerosols during the greater stability in the the lower atmospheric layers, was studied.

28182 (INPE—4197) Radon concentration inversions in the troposphere. Pereira, E.B. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jul 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702397/JAW.

Vertical concentrations of radon in the lower troposphere were obtained in Southern Brazil up to 7Km high and have shown unexpected inverted profiles. The presence of low pressure center systems southwest to the flight path suggested that inversions might have been originated by a vertical transport mechanism based on the large scale circulation of developing synoptic systems. A simple friction-driven circulation model was contructed and the transport equation was solved.

28183 (MRP/MRL—84-38F) Attachment of radon daughters to submicron aerosol particles. Grenier, M.G.; Bigu, J. (Department of Energy, Mines and Resources, Elliot Lake, Ontario (Canada). Elliot Lake Lab.). (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. Mining Research Labs.). Apr 1984. 27p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702470/JAW.

A study of the effects of aerosol concentration, aerosol size distribution and relative humidity on the Working Level and the radon daughter concentration was conducted in a 3000 L radon environmental chamber. Typical values of the aerosol concentration varied in the 1 x 10/sup 3/ particles/cm/sup 3/ to 4.5 x 10/sup 5/ particles/cm/sup 3/ range. Various size distributions of aerosols that have mean diffusional aerodynamic diameters of .025 μm, .045 μm and .090 μm were tested. A good correlation was found between the Working Level and the aerosol concentration as well as the relative humidity. Most of the activity seems to be associated with particles of diameter between .05 μm and .2 μm. The results presented here are in agreement with work done by other investigators in the health physics field.

28184 (PB—88-159777/XAB) Radon progeny in underground mines: a recommended standard for occupational exposure. (National Inst. for Occupational Safety and Health, Rockville, MD (USA)). Oct 1987. 227p. (DHHS/PUB/NIOSH—88-101). NTIS, PC A11/MF A01.

Also available from Supt. of Docs.

The National Institute for Occupational Safety and Health (NIOSH) recommends that worker exposure to radon progeny in underground mines be controlled by compliance with the recommended standard, which is designed to protect the health of underground miners over a working lifetime of 30 years. Mine operators should regard the recommended exposure limit for radon progeny as the upper boundary for exposure; the authors should make every effort to limit radon progeny to the lowest possible concentrations. The document presents the criteria and recommendations for an exposure standard that is intended to decrease the risk of lung cancer in miners occupationally exposed to short-lived, alpha-emitting decay products of radon (radon progeny) in underground mines. The REL for radon progeny applies only to the workplace and is not designed to protect the population at large. The REL is intended to (1) protect miners from the development of lung cancer, (2) be measurable by techniques that are valid, reproducible, and available to industry and government agencies, and (3) be technically achievable.

28185 (PB—88-160262/XAB) Radon-mitigation choices in the United States: a comparison of private- and public-sector developments. Witter, K.A.; Sanchez, D.C.; Craig, A.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jan 1988. 14p. (EPA—600/D-88/011). NTIS, PC A03/MF A01.

This paper compares private- and public-sector developments relating to radon mitigation in the U.S. In response to elevated radon levels in many U.S. houses, the Federal and State governments and the private sector have undertaken many varied mitigation and public-information efforts resulting in a range of radon-reduction installations in the U.S. Government-sponsored research and development of radon-mitigation techniques in single-family detached houses is compared with radon mitigation approaches undertaken by the private sector. An attempt is also made to compare premitigation diagnostics, the application of mitigation techniques to various substructure types, the performance of mitigation installations, and the cost of the installations. The information collected indicates that subslab ventilation is the most common technique in both public and private sector radon mitigation; however, air-to-air heat exchangers and sealing are employed more frequently in the private sector than in government-sponsored mitigation.

28186 (PB—88-160494/XAB) Risk assessment of exposure to waterborne and airborne radon-222 in Illinois. Final report. Hallenbeck, W.H. (Hallenbeck (William H.), La Grange, IL (USA)). Dec 1987. 80p. NTIS, PC A05/MF A01.

This study analyzed epidemiological and experimental animal studies in order to develop exposure-response relationships for radon-induced cancer. These relationships were used to estimate lifetime risks and annual excess cases based on the available waterborne and airborne data for Illinois. Exceedances of the USEPA action level of 4pCi/l occurred in 13% of 303 first-floor measurements and 43% of 1094 basement measurements. For waterborne radon, the highest lifetime risk of cancer mortality associated with an Illinois groundwater-based drinking water system was estimated to be 4 x 104. The number of excess cases of fatal cancer generated per year in Illinois was estimated to be about six. For airborne radon, a tentative value of 0.9 pCi/l (for first floors), derived from the limited existing data, was used to estimate the average lifetime lung-cancer mortality risk and the number of excess cases of fatal lung cancer generated per year. The average lifetime lung-cancer mortality risk was estimated to be 0.0048, and the annual number of excess cases of fatal lung cancer was estimated to be 784. Due to the nature of the underlying exposure-response relationships for radon-induced cancer, the values presented most likely represent upper-bound estimates.

28187 (PB—88-161534/XAB) Radon-reduction strategies and approaches. Cook, J.E.; Egan, D.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jan 1988. 42p. (EPA—600/D-88/022). NTIS, PC A03/MF A01.

This chapter is for inclusion in a textbook, Environmental Radon, for graduate students. It gives a flavor of what radon mitigation entails, rather than being a detailed handbook treatment of the subject. It emphasizes the removal or reduction of soil-gas-

borne radon (the major source of radon in most houses) and briefly describes the following methods of reducing/removing indoor radon: natural ventilation; forced air ventilation; forced air ventilation with heat recovery; reducing entry points (sealing); venting radon from the soil surrounding a house by drain-tile soil ventilation, sub-slab ventilation, or wall ventilation; reducing pressure differentials; removing radon from water; and air cleaning. It gives background information on house construction types, the significance of weather phenomena, and the significance of the stack effect in elevating indoor radon levels.

5004 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 28359

5006 Regulations

28188 **(PB—88-157813/XAB) National Air-Toxics Information Clearinghouse: how the Clearinghouse can help to answer your air toxics questions.** (Radian Corp., Research Triangle Park, NC (USA)). Jul 1986. 100p. (DCN—86-239-001-02-05). NTIS, PC A05/MF A01.

See also PB—87-125787.

The purpose of the report is to complement the effort now underway to prepare and implement multiyear development plans by showing how the Clearinghouse can help to answer questions commonly asked by State and local agencies involved with air-toxics assessment and control. Several sources were consulted to develop a series of questions and problem scenarios typical of those that State and local agencies might face in developing and implementing air-toxics control programs, handling complaints, completing new-source review permits, and carrying on other similar work that may not be part of a control program.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 27493

28189 **(INIS-BR—1028) Partitioning and redistribution of exogenous Ra/sup 226/ in farm soils from the vicinity of the First Brazilian Mine and Mill.** Teixeira, V.S.; Franca, E.P. (Rio de Janeiro Univ. (Brazil). Inst. de Biofisica). [1988]. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702292/JAW.

A sequential selective extration method was employed to assess the partitioning and redistribution of exogenous /sup 226/Ra into geochemical fractions of farm soils collected around the first Brazilian Uranium Mine and Mill. Six soil samples were contaminated in the laboratory by /sup 226/a solution, simulating an irrigation procedure. After selective extractions, /sup 226/Ra was analysed in six geochemical fractions: soluble (A); exchangeable (E); bound to carbonates (C); reducible (R); oxidizable (O); residual or matricial (M). The same method was also used in these soils before and after cultivation. The exogenous /sup 226/Ra was mainly associated to the (R) and (O) fractions followed by the (E) and (C) ones. Exchangeable /sup 226/Ra (fractions (A) + (E)) represents 21.8%. Statistically significant differences before and after cultivation were obtained only in the fractions (C) and (M).

28190 **(JINR—18-87-291) Neutron diffraction analysis of quartz in columnar gneiss of orthogneiss structure. Erzgebirge, Southern GDR.** Walther, K.; Drechsler, L.P.; Feldmann, K.; Fuentes, L.; Frischbutter, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Physik der Erde). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702428/JAW.

The crystalline preferred orientations of quartz grains in columnar gneiss from the Erzgebirge (Southern GDR) are studied by means of neutron time-of-flight diffraction. A single component texture has been found where the trigonal axes are parallel to the tectonic a-direction. In the quartz c-axis pole figure strong maxima at +-a are connected by a girdle of intensity being not found in U-stage measurements. From the comparison with experimentally deformed quartzites and model calculations the approximate formation conditions of the given columnar gneiss could be deduced. 15 refs.; 12 figs.; 1 tab.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 27952, 28216, 28217, 28219

28191 **(AD-A—188066/5/XAB) Surfactant-enhanced in-situ soils washing. Final report, March 1985-April 1986.** Nash, J.; Traver, R.P.; Downey, D.C. (Air Force Engineering and Services Center, Tyndall AFB, FL (USA). Engineering and Services Lab.). Sep 1987. 56p. (AFESC/ESL-TR—87-18). NTIS, PC A04/MF A01.

The objective of this joint Air Force - Environmental Protection Agency project was to demonstrate the feasibility of using surfactants to enhance the washing of petroleum and solvent-contaminated soils. A pilot-scale test of in-situ soils washing was performed at an abandoned fire training area using several surfactant solutions. The results of this study did not show in-situ soils washing as a proven and reliable remediation technology. Several shortfalls were observed and are documented in this report. The report also contains information on the operation of a groundwater treatment system which were successfully used to decontaminate highly polluted groundwater at the site.

28192 **(PB—88-165675/XAB) Soil-screening survey at four midwestern sites.** (Environmental Protection Agency, Westlake, OH (USA). Environmental Services Div.). Jun 1985. 163p. (EPA—905/4-85/005). NTIS, PC A08/MF A01.

In response to concerns about possible adverse public health impacts of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2378-TCDD) and other toxic chemicals in Midland, Michigan, the U.S. Environmental Protection Agency (USEPA) initiated a series of multi-media environmental studies in the Midland area. The major purpose of these studies is to define current environmental levels of 2378-TCDD and other toxic pollutants such that public health officials can make assessments regarding the potential public health risks associated with exposures in the area. The studies are also focused on determining the source or sources of these pollutants, and providing additional information and data which will be useful to the state of Michigan and the USEPA for environmental permitting for the Dow Chemical Company, Midland, Michigan plant.

28193 **(PB—88-165691/XAB) Collaborative study of the Toxicity Characteristics Leaching Procedure (TCLP).** Blackburn, W.B.; Show, I.; Taylor, D.R.; Marsden, P.J. (S-Cubed, San Diego, CA (USA)). Dec 1987. 86p. NTIS, PC A05/MF A01.

The United States Environmental Protection Agency has developed a new procedure, the Toxicity Characteristics Leaching Procedure (TCLP), to more effectively simulate the leaching of hazardous materials from waste disposed in an unsecured landfill. The procedure involves (1) an 18-hour extraction of a sample with sodium acetate solution and (2) the subsequent analysis of the leachate for metals, pesticides, semivolatile organics, and volatile organic compounds. To validate the method for all but the volatile organic analytes, 3 waste samples at 2 different pH levels were sent to 23 different volunteer government and commercial laboratories for extraction and analysis. For validation of the TCLP procedure involving determination of volatile organic compounds, two fortified waste samples were distributed to each participating laboratory.

28194 **(PB—88-170055/XAB) Assessing the reliability of flexible membrane liners.** Hartley, R.P. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Feb 1988. 21p. (EPA—600/D-88/029). NTIS, PC A03/MF A01.

The reliance on flexible membrane liners (FML) has arisen because they are impermeable to a variety of waste chemicals and they are easily produced at reasonable cost. Unfortunately, their long-term field performance remains to be proven. A multitude of design, construction, and operational factors has been identified as having greater or less potential for interfering with FML performance. Many of these factors can cause liner failure (leakage more than a specified amount). All of the factors must be recognized and their probability of occurrence and degree of performance interference estimated. From this information, a reliability prediction model can be constructed. As data on design, construction, operation, and actual performance of land-disposal systems accumulate, the model can then be verified and refined. The FML model will be integrated with similar analyses of other system components into an overall land-disposal-system reliability-prediction model.

28195 (PB—88-170105/XAB) Stringfellow leachate treatment with RBC (rotating biological contactor). Opatken, E.J.; Howard, H.K.; Bond, J.J. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Feb 1988. 21p. (EPA—600/D-88/013). NTIS, PC A03/MF A01.

A study was conducted with a rotating biological contactor (RBC) for treatment of leachate from the Stringfellow hazardous-waste site in Riverside County, California. The leachate was transported from California to Cincinnati, where a pilot-sized RBC was installed at the U.S. EPA's Testing and Evaluation (T&E) Facility. A series of kinetic runs were made with primary effluent from the City of Cincinnati's Mill Creek Sewage Treatment Plant to develop a biomass on the disks and to obtain a standard kinetic removal rate. These runs were then followed with Stringfellow leachate experiments that included operations at various ratios of leachate to primary effluent, operations at 100% leachate, and operations to increase the percentage removal of dissolved organics. The paper reports on the results from these experiments and the effectiveness of an RBC to adequately treat leachate from the Stringfellow hazardous-waste site.

28196 (PB—88-860622/XAB) Leachate treatment. January 1972-March 1988 (Citations from Pollution Abstracts). Report for January 1972-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 44p. NTIS PC N01/MF N01.

Supersedes PB—87-855078.

This bibliography contains citations concerning a variety of methods utilized in the treatment of leachates. Solvent extraction, lagooning, ultrafiltration, and activated sludge are among the techniques considered. Leachate from landfills, coal piles, and chemical wastes is discussed. (This updated bibliography contains 116 citations, 19 of which are new entries to the previous edition.)

28197 Comparisons of laboratory waste extracts with field leachates. Francis, C.W.; Maskarinec, M.P. (Oak Ridge National Lab., TN (USA)). pp 22-25 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—). Contract AC05-84OR21400.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

This paper examines the accuracy of several leaching tests in defining the toxicity characteristics of industrial wastes codisposed in municipal waste landfills. The goal was to simulate leaching of both organic and inorganic constituents of leachates from industrial wastes. Large-scale lysimeters were used to generate an anoxic municipal waste leachate which was then used in field leaching tests of industrial wastes. The organic and inorganic target species obtained from these tests were compared with those obtained from rotary-batch and upflow-column extractions using four extracting media. Four methods of comparison were also analyzed; of these, the multivariate method was considered most appropriate.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 27490, 27509

28198 (AD-A—188098/8/XAB) Preparation of radiolabeled trichothecenes, simple trichothecenes for generation of generic antibodies, and a study of the fate of trichothecenes in soil. Final report, 1 September 1985-1 November 1986. Jarvis, B.B. (Maryland Univ., College Park (USA). Dept. of Chemistry). 12 Jan 1987. 40p. NTIS, PC A03/MF A01.

The objectives of this research fell into three areas: (1) preparation of radiolabeled macrocylic trichothecenes and their subsequent use in studies of trichothecene metabolism in mammalian systems; (2) preparation of a series of modified trichothecenes which will be useful in the preparation of generic antibodies for the simple trichothecenes; and (3) study of the transport in solis and plants by the trichothecenes, in order to determine the long-term ecological effects of trichothecenes contamination of highly contaminated areas. 15-3H-verrucarol was prepared by two different synthetic procedures. Verrucarin A was labeled with tritium to give 2'-3H-verrucarin A and 16-3H-verrucarin A. Two nontoxic trichothecenes were prepared, one of which has a 4,15-ether bridge and the other has an 8,15-ether bridge. Roridin A was shown to bind irreversibly to soils, with the percent recovery from spiked-soil sample decreasing with time and decreasing with decreasing concentration of mycotoxin in the soil. The potent cytotoxin myrotoxin B was isolated from a fungal culture and submitted for toxicological evaluation.

28199 (INIS-BR—1033) Natural gamma radiation in rooms of a building in the Pontificia Universidade Catolica (PUC/RJ), Brazil. Pinho, R.R. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1986. 157p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702297/JAW.

Gamma radiation in a set of rooms of the sector D of the Cardeal Leme Building in the Pontifica Universidade Catolica of Rio de Janeiro, and also in some outdoors ares at the PUC/RJ campus, are examined using well established experimental techniques. The exposures were obtained by using CaSO/sub 4/:Dy thermoluminescent dosimeters and one NaI(Tl) crystal associated with a multichannel pulse height analyser to store the gamma ray spectra of the locations chosen for the measurements. Outdoors, the average of the actual readings of exposures rates obtained at PUC/RJ campus remained around 2,5x10/sup -2/ mC/Kg.y (98 mR/year), while indoors the average exposure rates were in some cases three times higher than the equivalent average obtained outdoors. Some of potential causes to the fact that exposure to gamma radiation is, in general, higher indoors than outdoors are examined and discussed.

28200 (INIS-mf—11204) Radiation in the environment. Results of the Dutch research program Radiation aspects of dwelling hygiene and related radioecological problems. (Stichting Projectbeheerbureau Energieonderzoek (PEO), Utrecht (Netherlands)). Mar 1986. 48p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702381/JAW.

In this brochure a general survey is presented of the SAWORA (Dutch abbrevation for 'Radiation aspects of dwelling-hygiene and related radio-ecological problems') research-program and its results. In this program emphasis lay upon indoor radiation burden. Therewith a distinction has to be made between external and internal radiation burden of men. In this context the external burden is accounted for by gamma radiation while the internal burden depends predominantly upon the concentration of radon in the air and radioactive materials in the body. After a short explanation of the concept of radiation in ch. 2, attention is devoted to gamma radiation and radon concentration in the open air in ch. 3, furthermore the radionuclide concentrations of the Dutch soil are discussed. In ch. 4 the radio-ecological aspects of fly-ash powder and gypsum are treated and, in ch. 5, those of building materials. Ch. 6 deals with indoor gamma-radiation. In ch. 7 a survey is given of radon concentrations in Dutch dwellings and the observed differences in concentrations. The synthesis of the various factors

which influence the indoor radiation burden, the way in which radon and radondaughters enter the lungs and their contribution to the origin of lung carcinomas are discussed in ch. 8, together with the computer model with which the radiation aspects of certain building-technical developments can be calculated. Ch. 9 finally summarizes the most important results of the SAWORA program. 34 refs.; figs.

28201 **Technetium-99 cycling in deciduous forests: review and ecosystem model development.** Garten, C.T. Jr. (Oak Ridge National Lab., TN (USA)). *Environment International;* 13: No. 4-5, 311-321(1987). Contract AC05-84OR21400.

A model is presented to summarize the fate of technetium-99 (/sup 99/Tc) in a woodland site amidst an old radioactive waste disposal area in the eastern U.S. Rate constants for /sup 99/Tc transfer between the biological and physical components of the forest were derived based on field measurements and associated laboratory studies. The fate of /sup 99/Tc in the woodland occupying the drainage area immediately adjacent to the disposal site was simulated with the derived rate constants and some assumptions about relative inputs to and outputs from the surface soil available pool in the model forest. A steady state in the distribution of /sup 99/Tc among soil compartments and forest compartments was reached in simulations after {similar←to} 30 years of continuous input to the soil available pool. If the rate of /sup 99/Tc export from the soil available pool exceeded inputs to the pool by ten times, then the model forest had little impact on the cumulative loss of /sup 99/Tc from the system. Under steady state conditions, 42% of the total / sup 99/Tc input to the system during a 34-year period was retained by the forest, mostly in the unavailable mineral soil pool.

28202 **Field sampling for monitoring, migration and defining the areal extent of chemical contamination.** Thomas, J.M.; Skalski, J.R.; Eberhardt, L.L.; Simmons, M.A. (Pacific Northwest Lab., Richland, WA (USA)). pp 85-89 of Management of uncontrolled hazardous waste sites. Silver Spring, MD; Hazardous Materials Control Research Institute (1984). (CONF-841137—). Contract AC06-76RL01830.

From 5. national conference on management of uncontrolled hazardous waste sites; Washington, DC, USA (7 Nov 1984).

As part of two studies funded by the U.S. Nuclear Regulatory Commission and the USEPA, the authors have investigated field sampling strategies and compositing as a means of detecting spills or migration at commercial low-level radioactive and chemical waste disposal sites and bioassays for detecting contamination at chemical waste sites. Compositing (pooling samples) for detection is discussed first, followed by the development of a statistical test to determine whether any component of a composite exceeds a prescribed maximum acceptable level. Subsequently, the authors explore the question of optimal field sampling designs and present the features of a microcomputer program designed to show the difficulties in constructing efficient field designs and using compositing schemes. Finally, they propose the use of bioassays as an adjunct or replacement for chemical analysis as a means of detecting and defining the areal extent of chemical migration.

5106 Regulations

REFER ALSO TO CITATION(S) 28234

28203 **(PB—88-172978/XAB) Superfund Record of Decision (EPA Region 2): Cooper Road Dump, Camden County, New Jersey (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 29p. (EPA/ROD/R—02-87/049). NTIS, PC A03/MF A01.

The Cooper Road site consists of a 100-square foot dumping area located in Voorhees Township, Camden County, New Jersey. In 1982 several dozen, one-to-two ounce, glass vials containing unknown liquids were discovered at the site. Some vials were broken, but most remained intact. Sampling of the vials by the New Jersey Department of Environmental Protection (NJDEP) indicated the presence of benzene, ethylbenzene, xylene, naphthalene, and other contaminants. NJDEP requested the owners of the property perform a complete and total removal of all vials. No response from the site owners followed. The site changed ownership in June 1983, and upon request by NJDEP, the new owners removed all vials and six inches of underlying soil. Subsequent sampling of soil and ground water indicate no contaminants present above normal background levels. EPA determined that no significant risk or threat to public health and the environment exists and therefore no further action will be taken at this site. There are no implementation issues or costs associated with this no action remedy.

28204 **(PB—88-172986/XAB) Superfund Record of Decision (EPA Region 4): Parramore Surplus Company site, Mt. Pleasant, Florida (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 15 Sep 1987. 71p. (EPA/ROD/R—04-87/025). NTIS, PC A04/MF A01.

The Parramore Surplus Company (PSC) site, occupying approximately 25 acres, is located in Mt. Pleasant, Gadsden County, Florida. PSC is an active facility which stores and resells surplus government products purchased from naval airbases in Florida and Alabama in 1972. Most of the site is used for vehicle and equipment storage. In March 1982, the Florida Department of Environmental Regulation (FDER) inspected the site and estimated that 400-600 drums were stored onsite with many leaking and killing vegetation. PSC conducted limited cleanup activities which included the removal of hazardous chemicals and contaminated soil. EPA denied an August 1983 request by PSC to delete the site from the NPL because no data existed to show that the soil removal was effective in remedying surface contamination. In March 1985, EPA conducted a Modified Remedial Investigation which detected elevated levels of organic compounds in the soil and detected sediments in the ground water. However, the analytical results were not considered indicative of true site conditions. EPA has determined that the onsite contaminated soil poses no risk to human health or the environment and that further soil or ground water remediation is not necessary.

28205 **(PB—88-172994/XAB) Superfund Record of Decision (EPA Region 5): Industrial Excess Landfill site, Uniontown, Ohio (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 86p. (EPA/ROD/R—05-87/056). NTIS, PC A05/MF A01.

The Industrial Excess Landfill (IEL) is a 30-acre closed sanitary landfill located in Uniontown, Stark County, Ohio. Over 400 residential homes, located within a 0.5 mile radius of the landfill, rely entirely on individual or private well supplies for drinking water. Prior to 1961, the landfill property may have been utilized as a coal mine and later for mining sand and gravel. Gradually, the mining/excavation pit was converted into a landfill which received a variety of wastes. Between 1964 and 1968, the site was used to store fly ash, masonry rubble, paper and lumber scrap. From 1968 to 1980, IEL accepted municipal, commercial, industrial, and chemical wastes of substantially undetermined and unknown composition, primarily from the nearby rubber industry. Large quantities of chemical and liquid waste were dumped onto the ground either from 55-gallon drums or from tanker trucks. In January of 1972, the Stark County Board of Health (SCBH) ordered the dumping of chemical wastes stopped. In 1980, due to public concern and facility volume limitations, the landfill was ordered to close.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

28206 **(PB—88-158845/XAB) Evaluation of an aquatic ecoregion classification of streams in Arkansas.** Rohm, C.M.; Giese, J.W.; Bennett, C.C. (Northrop Services, Inc., Corvallis, OR (USA)). 1987. 17p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Freshwater Ecology, Vol. 4, No. 1, 127-140(Jun 1987).

The efficacy of a regional-stream classification system, based on the principle that streams reflect the character of the lands they drain, was evaluated in Arkansas. The classification consisted of six aquatic ecoregions defined by relatively homogeneous types of

land-surface form, soil, potential natural vegetation and land use. Fish, physical habitat and water quality were sampled in 22 streams throughout the state. Data subjected to ordination analysis generally showed greater similarity in streams within the same ecoregion than in streams in different ecoregions.

28207 **(PB—88-170402/XAB) Gulf of Mexico physical oceanography program final report: year 4. Volume 1. Executive summary.** (Science Applications International Corp., Raleigh, NC (USA)). Feb 1987. 23p. (SAIC—87/1026). NTIS, PC A03/MF A01.

See also PB—88-170782, and PB—87-107405.

The particular program, the Gulf of Mexico Physical Oceanography Program, has two primary goals: (1) develop a better understanding and description of conditions and processes governing Gulf circulation; and, (2) establish a data base that could be used as initial and boundary conditions by a companion MMS-funded numerical circulation-modeling program. The area to be studied emphasizes the deeper Gulf and those shallower regions where conditions may be directly or indirectly affected by patterns associated with or originating in the deeper Gulf. The multi-year, phased program will investigate the eastern and western Gulf separately. The report presents results from 3 years of observations in the eastern Gulf.

28208 **(PB—88-170782/XAB) Gulf of Mexico physical oceanography program final report: year 4. Volume 2. Technical report.** (Science Applications International Corp., Raleigh, NC (USA)). Feb 1987. 320p. (SAIC—87/1027). NTIS, PC A14/MF A01.

See also PB—88-170402.

The particular program, the Gulf of Mexico Physical Oceanography Program, has two primary goals: (1) develop a better understanding and description of conditions and processes governing Gulf circulation; and, (2) establish a data base that could be used as initial and boundary conditions by a companion MMS-funded numerical circulation-modeling program. The program participants undertook the following primary scientific efforts during Program Year 4: (1) kinematic and hydrographic characterizations of Loop Current boundary features, e.g., waves, filaments, or perturbations; (2) comparative kinematics and dynamics of the Loop Current and a Loop Current eddy as indicated by drifting buoy trajectories; and (3) further discrimination and characterization of West Florida Shelf circulation patterns, e.g., inertial currents, wind, and Loop Current forced currents.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 27455, 27459, 27498, 27540, 27805, 27856, 28113, 28114, 28115, 28191, 28195, 28196, 28229, 28230, 28231, 28283

28209 **(PB—88-157631/XAB) Acid/neutral continuous liquid/liquid extraction of priority pollutants and hazardous-substance-list compounds. Final report.** Slayton, J.L.; Trovato, E.R. (Environmental Protection Agency, Annapolis, MD (USA). Central Regional Lab.). Jan 1988. 67p. (EPA—903/9-88/001). NTIS, PC A04/MF A01.

Continuous liquid-liquid extraction was compared to manual extractions per EPA Method 625, but employing an acid-neutral scheme. The results from EPA performance evaluation (quality control) wastewater, Superfund, and RCRA samples are compared using the two extraction techniques. Continuous liquid-liquid extractions following an acid-neutral scheme were compared to those following a base-neutral scheme. The acid-neutral continuous extraction scheme was determined to be effective elegant and labor saving. Emulsion formation was reduced and the recoveries of phenol, 4-nitrophenol, pentachlorophenol, and benzoic acid were significantly improved by using the continuous extractor. The acid-neutral scheme as opposed to the Method 625 base-neutral extraction was found to greatly improve the recovery of dimethyl-, diethyl-, di-n-butyl-, and n-butyl benzyl phthalate esters. The levels of target and additional compounds extracted using a continuous extractor from the environmental samples tested equaled or exceeded those obtained from manually extracted samples.

28210 **(PB—88-158787/XAB) Critical assessment of effects of acidification on fisheries in North America.** Magnuson, J.J.; Baker, J.P.; Rahel, F.J. (North Carolina State Univ., Raleigh (USA)). 1984. 19p. NTIS, PC A03/MF A01.

Pub. in Phil. Trans. R. Soc. Lond. B 305, 501-516(1984).

Three types of evidence are available: field comparative studies across pH gradients (space or time); laboratory experiments where pH is manipulated; and field experiments in which the pH of lakes or streams is manipulated. Most inferences have been made from comparative studies, the least in field manipulations. The judgments were that the strength of a statement on effects was increased when two or more types of information supported the conclusion. A weakness in the North American experience is the absence of field-manipulative experiments. Also, the observed correspondence among results inferred by all three types of evidence, strengthened results available only from comparative studies or only from laboratory studies. It is clear that, when acidification occurs, fisheries have been and will be damaged by loss of fish, reductions in benthic and planktonic invertebrates, and possibly by the accumulation of periphyton and detritus. Functional responses of aquatic ecosystems are more poorly known. Expected pH values of sensitive waters in the USA after long-term acidification are expected to be between pH 4.3 and 4.9.

28211 **(PB—88-158829/XAB) Separation of metals in wastewater sludge by centrifugal classification.** Fronk, C.A.; Farrell, J.B.; Strachan, W. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Nov 1985. 11p. (EPA—600/J-85/514). NTIS, PC A03/MF A01.

Pub. in Jnl. of Environmental Progress, Vol. 4, No. 4, 269-276(Nov 1985).

Municipal wastewater sludges frequently contain undesirably high concentrations of heavy metals and/or organic pollutants that interfere with beneficial use of sludge on farmland and with some disposal practices such as ocean disposal. Centrifugal classification is a low-cost procedure that has been demonstrated in the study to concentrate contaminants into the centrate stream, thus reducing the contaminants in the centrifuge cake and upgrading it for beneficial use. Experiments with a small solid-bowl continuous decanter centrifuge were conducted to show the effects of machine and process variables (e.g., centrifuge speed, flow rate) on separation of heavy metals. Recovery factors varied from day to day, no doubt as a result of changes in the sludge. Results from a full-scale installation at a Los Angeles County plant showed similar recovery factors, differing in some details. Examination of three years of Los Angeles' operational data showed consistent separation with no marked trends. Los Angeles data also showed substantial concentration of organic pollutants into the centrate solids.

28212 **(PB—88-158936/XAB) Coliform non-compliance nightmares in water-supply distribution systems.** Geldreich, E.E. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Jan 1988. 43p. (EPA—600/D-88/005). NTIS, PC A03/MF A01.

Coliform occurrences in distribution systems have created a great concern for both utilities and water authorities because of the implied public-health implications and failure to meet Federal regulations. Many of the known cases involve systems in the east and midwest. The common denominator being systems that have significant amounts of pipe networks over 75 years old and all are treating surface waters. Origins for these contamination events can be found in source-water fluctuations, failures in treatment-barrier protection, or loss of pipe-network integrity. Once passage into the distribution network has been achieved, some of the coliforms (Klebsiella, Enterobacter, Citrobacter) and other heterotrophic bacteria adapt to the pipe environment, finding protection and nutrient support in pipe sediments. Under conditions of seasonal warm waters (10 degC) and availability of assimilable organics in the pipe sediments and tubercles, colonization grows into biofilms that may slough-off into the water supply, creating a coliform non-compliance problem. Significance of these occurrences and control measures are part of a realistic action plan presented for guidance.

28213 **(PB—88-159058/XAB) Removal of organics from drinking water.** Lykins, B.W. (Environmental Protection Agency, Cincinnati, OH (USA). Drinking Water Research Div.). Jan 1988. 24p. (EPA—600/D-88/008). NTIS, PC A03/MF A01.

Organic contamination of drinking water is basically caused by two general classes of organics; man-made synthetic organics and disinfection of naturally occurring organics (disinfection by-products). Many volatile and non-volatile synthetic organics at trace concentrations are being detected in surface and ground waters. Contaminated ground water usually contains two or more predominant organic compounds and several other identifiable ones at lesser concentrations. Surface waters, such as rivers, generally contain many organic compounds in low concentrations. The document summarizes the treatment technologies that EPA's Drinking Water Research Division (DWRD) is evaluating for removal of VOCs, SOCs, and disinfection by-products from water supplies. Carbon adsorption is effective for removing both VOCs and SOCs. Packed-tower and diffused aeration are best suited for removing VOCs. Of the technologies that show promise and are being tested at the bench and pilot scales, conventional treatment with powdered activated carbon (PAC) is effective for removing a few of the SOCs, ozone oxidation is effective for removing certain classes of VOCs and SOCs, and certain reverse osmosis membranes and ultraviolet treatment are also potentially effective against VOCs and SOCs.

28214 **(PB—88-160502/XAB) Total exposure and risk assessment for drinking water contaminated with volatile organic compounds. Final report.** Clark, J.M.; Fuller, C.L. (Illinois Univ., Chicago (USA). School of Public Health). Dec 1987. 129p. NTIS, PC A07/MF A01.

A total-exposure and cancer-risk assessment was conducted on nine volatile organic compounds (VOCs) frequently found in contaminated drinking water. Routes of exposure considered in the analysis included ingestion, inhalation, and dermal uptake. A total of ten exposure scenarios were constructed, reflecting minimum and maximum likelihood exposures. The total exposure scenarios developed for VOCs, the most extensive reported to date, clearly supports the need to consider non-ingestion exposure routes in the development of drinking water standards for VOCs. Recent maximum contaminant levels (MCLs) developed by USEPA for six of the VOCs evaluated in the study appear not to have been derived considering the non-ingestion exposure routes. Moreover, as the new MCLs result in cancer risks of 10 to the minus 6 power to 10 to the minus 3 power, using the exposure relationships developed in the study, they may be insufficiently protective of public health. As inhalation and possibly dermal exposure routes may be more significant than the ingestion route, regulatory agencies should determine the risks before permitting drinking waters, significantly contaminated with VOCs, to be used for bathing or cooking for long time periods prior to obtaining an alternative water supply or implementing other corrective measures.

28215 **(PB—88-161559/XAB) Screening of semivolatile organic compounds for extractability and aqueous stability by SW-846 Method 3510.** Engel, T.M.; Kornfeld, R.A.; Warner, J.S.; Andrews, K.D. (Battelle Columbus Labs., OH (USA)). Jan 1988. 91p. NTIS, PC A05/MF A01.

As part of an ongoing effort in a heirarchical scheme to demonstrate the applicability of present U.S. Environmental Protection Agency (USEPA) analysis methods for the Resource Conservation and Recovery Act (RCRA), the suitability of SW-846 Method 3510 for the determination of hazardous, organic compounds was evaluated. The compounds selected for the study included 153 semivolatile organic compounds on Appendix VIII to 40 CFR Part 261 (including the Michigan List, Federal Register, December 21, 1984), that is a previous part of the program had shown to be amenable to gas chromatographic/mass spectrometric (GC/MS) analysis. The extraction efficiency from water and seven-day aqueous stability of the compounds were determined to provide in part, basic information for the finalization of a subset of Appendix VIII suitable for groundwater monitoring.

28216 **(PB—88-164090/XAB) Impacts of sewage effluent on tree survival, water quality and nutrient removal in coastal plain swamps.** Kuenzler, E.J. (North Carolina Water Resources Research Inst., Raleigh (USA)). Sep 1987. 102p. (UNC-WRRI—87-235). NTIS, PC A06/MF A01.

An investigation was conducted of the impacts of sprayed municipal sewage on swamp tree survival and the effects of the swamp system on nutrient concentrations below the outfalls on two streams on the coastal plain of North Carolina. Effluent was discharged to one swamp stream by aerial spraying and to the other stream by way of a small ditch. Ninety-eight percent of the trees struck directly by the spray were dead within 18 months of the date spraying began. Both swamp systems removed sufficient quantities of nitrogen and phosphorus within a few kilometers to account for virtually all of the sewage nutrient load to the swamps.

28217 **(PB—88-164322/XAB) Nitrate retention as it affects groundwater pollution in Mid-Atlantic soils. Completion report.** Sparks, D.L. (Delaware Univ., Newark (USA). Dept. of Plant Science). 14 Sep 1987. 53p. NTIS, PC A04/MF A01.

Nitrate retention (NO_3) as it affects groundwater pollution was investigated on nine major Mid-Atlantic soil types. Objectives of the study were to determine the magnitude and rate of NO_3 retention and the effect of anion competition on NO_3 retention. The soils had a wide range in organic matter, clay and oxide content. Charge properties including anion exchange capacity (AEC) and point of zero salt effect (PZSE) were determined. The PZSE values were low indicating little anion-adsorption capacity, while AEC values often significant and increased with profile depth as oxide and clay contents increased.

28218 **(PB—88-166863/XAB) Guide to the application of quality-assurance data to routine survey data analysis.** Paulsen, S.G.; Chen, C.L.; Stetzenbach, K.J.; Miah, M.J. (Nevada Univ., Las Vegas (USA)). Jan 1988. 74p. NTIS, PC A04/MF A01.

The National Surface Water Survey of the National Acid Precipitation Assessment Program was designed to evaluate the present status of the nation's surface waters with regard to the problem of acidic precipitation. The report provides assistance in utilizing the quality-assurance data when interpreting the routine survey data. The quality assurance reports for each of the surface-water surveys, Eastern Lake Survey - Phase I, Western Lake Survey - Phase I, National Stream Survey - Phase I and Eastern Lake Survey - Phase II provide detailed information on the detectability, accuracy, and precision of the routine lake data collected within each of these surveys. The data contained in the quality-assurance reports pertaining to each of these issues can provide additional information which can enhance the analysis of the routine lake data and extend the applicability of the survey data beyond the original intent by providing future investigators the kind of detailed information about the quality of the data which is necessary when applying the data to studies for which it was not designed.

28219 **(PB—88-170667/XAB) Environmental contamination by polychlorinated dibenzo-p-dioxins and dibenzofurans associated with pulp and paper mill discharge.** Kuehl, D.W.; Butterworth, B.C.; DeVita, W.M.; Sauer, C.P. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). 1987. 7p. (EPA—600/J-87/217). NTIS, PC A02/MF A01.

Pub. in Biomedical and Environmental Mass Spectrometry, Vol. 14, 443-447(1987).

Sludge from seven pulp and paper mills was analyzed for 2,3,7,8-TCDD. The level of contamination ranged from not detectable (1pg/g) to over 400 pg/g. Analyses for other planar polychlorinated contaminants indicated high levels of contamination by other PCDDs and PCDFs. Polychlorinated xanthenes and xanthones were identified as potential interferences in these analyses.

28220 (PB—88-170741/XAB) Wastewater management for coastal cities: the ocean-disposal option. Technical paper. Gunnerson, C.G. (International Bank for Reconstruction and Development, Washington, DC (USA)). 1988. 422p. (WORLD-BANK-TP—77). NTIS MF A01.

Also pub. as International Bank for Reconstruction and Development, Washington, DC. rept. no. UNITED NATIONS DEVELOPMENT PROGRAM PROJECT MANAGEMENT-8; Library of Congress catalog card no. 87-32055; Microfiche copies only. Paper copy available from World Bank, 1818 H St., NW, Washington, DC 20433.

This manual presents information on wastewater-management practices for coastal cities and the options available for protecting the ocean coastal environment. It reviews the current state of knowledge on the planning, design, and construction of ocean outfalls for ultimate disposal in the marine environment. The paper is geared to engineers, planners, municipal authorities, and others interested in the subject. The scope of the manual includes the scientific basis for understanding what happens to wastes discharged into the nearshore marine environment and the implications for appropriate ecological design. It also covers the engineering framework for outfall planning and site selection, hydraulic design of outfall pipelines and diffusers, selection of pipeline material, analysis of on-bottom stability and stresses on pipelines, and determination of shore approaches.

28221 (PB—88-858626/XAB) Wastewater treatment: lagoons. January 1977-February 1988 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-February 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 158p. NTIS PC N01/MF N01.

Supersedes PB—86-867884.

This bibliography contains citations concerning the treatment and storage of wastewaters in lagoons. The design, operation, equipment, and pretreatment processes are discussed. The treatment of wastewater from breweries, tanneries, paper mills, and other industrial operations are considered. Descriptions and evaluations of specific facilities are provided. (This updated bibliography contains 294 citations, 18 of which are new entries to the previous edition.)

28222 (PB—88-859509/XAB) Sewage-sludge pretreatment and disposal. December 1981-February 1988 (Citations from the NTIS data base). Report for December 1981-February 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 160p. NTIS PC N01/MF N01.

Supersedes PB—86-857398.

This bibliography contains citations concerning techniques and equipment utilized in the pretreatment processes and disposal of sewage sludges. Topics include resource and energy recovery operations, land disposal, composting, ocean disposal, and incineration. Digestion, dewatering, and disinfection are among the pretreatment processes discussed. Environmental aspects, including the effects on soils, plants, and animals are also presented. (This updated bibliography contains 323 citations, 74 of which are new entries to the previous edition.)

28223 (PB—88-860366/XAB) Asbestos in drinking water. January 1977-March 1988 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 75p. NTIS PC N01/MF N01.

Supersedes PB—87-854402.

This bibliography contains citations concerning the occurrence, and problems associated with asbestos-fiber contaminated drinking water. The role of asbestos cement pipes and factors involved in the release of asbestos fibers are discussed. Distribution data, epidemiology studies, and health effects are considered. Detection and measurement methods are also discussed. (This updated bibliography contains 137 citations, 12 of which are new entries to the previous edition.)

28224 (PB—88-861083/XAB) Sediment transport in rivers. January 1978-March 1988 (Citations from the NTIS data base). Report for January 1978-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 114p. NTIS PC N01/MF N01.

Supersedes PB—85-858991.

This bibliography contains citations concerning a variety of topics pertaining to river sediment-transport processes. Channel degradation and aggradation, water-quality aspects, and evaluation and monitoring studies in specific areas are among the subject areas considered. Considerable attention is given to computer simulations of transport processes. (This updated bibliography contains 219 citations, 80 of which are new entries to the previous edition.)

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 28186

28225 (INIS-BR—1026) Interactions between thorium and humic compounds in surface waters. Miekeley, N.; Kuechler, I.L. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702291/JAW.

Thorium and dissolved organic compounds were determined in surface waters from a thorium-rare earth deposit. Highest concentrations of Th-232 were analysed in organic-rich percolation waters, in wich this element is associated with colloidal humic acid, as shown by ultrafiltration experiments. Correlation between the concentration of humic carbon in water and that of Th-232 was observed. The presence of these natural complexants also affects the distribution of thorium between water and suspended clay material, as demonstrated by radioactive tracer experiments.

28226 (IOS-Rep—281) Dispersion of tracers by the oceanic eddy field modelling programme. Final report, October 1987. Richards, K.J.; O'Farrell, S.P. (Institute of Oceanographic Sciences, Godalming (UK)). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753094/JAW.

A numerical model has been developed to study the dispersion of tracers by the oceanic eddy field. The present study is designed to study the dispersion of particles in a mesoscale eddy field produced by the numerical model. Dispersion rates are calculated for flows above three types of topography, a flat bottom, a random collection of hills and a ridge. The presence of topography is found to significantly affect the flow. The effective diffusion coefficient of the flow near the bottom is reduced by 20% for the random topography and 60% for the ridge from that for the flat bottom case. Estimates are given of the number of float years required to obtain a given accuracy for the diffusion coefficient. At the surface a modest number of floats (order 5) are required to obtain a 50% accuracy. However at the bottom, to be within a factor of 2 of the true value for the flows considered requires respectively 26, 42 and 103 float years for the flat, random and ridge cases.

28227 (PB—88-158464/XAB) Study of possible economical ways of removing radium from drinking water. Valentine, R.L.; Splinter, R.C.; Mulholland, T.S.; Baker, J.M.; Nogaj, T.M. (Iowa Univ., Iowa City (USA)). Jan 1988. 105p. NTIS, PC A06/MF A01.

This study was undertaken to determine variables that control the incidental removal of radium that has been observed to occur as a consequence of treatment to remove iron by oxidation--sand filtration. The study also evaluated the possibility of exploiting these factors to provide an inexpensive means of removing radium using existing or modified iron removal facilities. Studies were also conducted to evaluate radium sorption to hydrous manganese oxides and to evaluate the potential of radium sorption to filter sand as a novel removal technology. Results showed that radium sorption to iron and manganese oxides and filter sand appear to be controlled primarily by the presence of calcium and magnesium, which are believed to compete for sorption sites.

28228 **Pearl Harbor bombing attack: a contamination legacy revealed in the sedimentary record.** Ashwood, T.L.; Olsen, C.R. (Oak Ridge National Lab., TN (USA)). *Marine Pollution Bulletin;* 19: No. 2, 68-71(Feb 1988).

Sediment cores collected from Middle Loch and West Loch of Pearl Harbor were dated using fallout /sup 137/Cs and excess / sup 210/Pb and analysed for several major elements and trace metals. Results indicate that sediment deposited immediately following the 7 December, 1941, bombing attack on Pearl Harbor contained elevated levels of several trace metals.

5205 Site Resource And Use Studies

28229 **(PB—88-164611/XAB) Fiscal Year 1986 program report: Pennsylvania Center for Water Resources Research.** (Pennsylvania State Univ., University Park (USA). Environmental Resources Research Inst.). Aug 1987. 36p. (ER—8713). NTIS, PC A03/MF A01.

See also PB—85-233740.

Three projects and a program of technology transfer were conducted during Fiscal Year 1986. Focused on acid rain, protection of domestic water supplies, and drought-management strategies, the program addressed state as well as regional priorities. The Institute's 1986 technology transfer efforts emphasized programs dealing with groundwater resources and contamination, water supply, and treatment.

28230 **(PB—88-164694/XAB) Fiscal Year 1986 program report: Utah Water Research Laboratory.** James, L.D. (Utah State Univ., Logan (USA). Utah Water Research Lab.). Aug 1987. 28p. NTIS, PC A03/MF A01.

See also PB—87-112397.

Within the $3.1 million research program underway in 14 major program areas at the Utah Water Research Laboratory, two are being developed with USGS funds through the Utah Center for Water Resources Research. Both involve interdisciplinary interaction. One area examines and quantifies fundamental meteorologic and surface and groundwater processes in closed desert basins in order to be better able to manage the limited water resources in these arid lands around desert playas. The second addresses fundamental chemical and biological processes for protecting water supplies from hazardous wastes with the immediate application being the threat to ground water from toxic organic chemicals, (largely petroleum-related in Utah). During fiscal year 1986, UCWRR supported three projects on desert basin hydrology and two on protecting ground-water-supplies from organic chemicals. One project on ground-water quality protection characterizes petroleum products leaking from underground storage tanks and evaluates their toxicity by testing impacts on mice as a guideline in setting priorities for cleanup programs.

28231 **(PB—88-164702/XAB) Fiscal Year 1986 program report: Tennessee Water Resources Research Center.** (Tennessee Univ., Knoxville (USA). Water Resources Research Center). Aug 1987. 32p. NTIS, PC A03/MF A01.

See also report for FY 85, PB—87-122073.

This report details the FY 86 research program accomplished by the Tennessee Water Resources Research Center under the U.S. Department of Interior's State Water Resources Research Institute Program. The report provides an overview of three (3) research projects and information-transfer activities carried out during the FY 86 program period. Project 02 is a continuation and expansion of work begun in 1985 on hazardous-waste-management in Tennessee. Project 03 focused on identification and evaluation of alternative approaches to the protection and management of wetlands in Tennessee. Project 04 involved the completion of a two-year research project that investigated the problems related to the construction of private levees in the floodplains of West Tennessee river systems. The information-transfer program involved conferences and workshops, publication of technical reports, and the orderly transfer of current information to water resources researchers.

5206 Regulations

REFER ALSO TO CITATION(S) 28203, 28204, 28205

28232 **(PB—88-149786/XAB) Looking at user charges: a state survey and report.** (Environmental Protection Agency, Washington, DC (USA). Office of Municipal Pollution Control). Sep 1987. 38p. (EPA—430/09-87/0008). NTIS, PC A03/MF A01.

The guidance provides financial and technical information through a community outreach program and ensures that EPA-funded localities comply with Clean Water Act requirements for user-charge systems.

28233 **(PB—88-172960/XAB) Superfund Record of Decision (EPA Region 3): Presque Isle Site, Erie, Pennsylvania (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 104p. (EPA/ROD/R—03-87/037). NTIS, PC A06.

The Presque Isle site is located on the Presque Isle State Park Peninsula within the city of Erie, Erie County, Pennsylvania. The site consists of a plugged, abandoned natural gas well encompassing an area of approximately 100 sq ft. In the early 1970s, the Erie County Health Department noted a seep discharging a noxious, hydrogen sulfide-bearing black liquid. Investigations focused around whether the liquid was a natural brine emanating from the underlying Bass Island geologic formation, or was related to the deep-well injection of spent paper pulping liquid by a nearby paper mill. The Presque Isle well was plugged in 1982, and subsequent investigations have revealed no further release of the hazardous liquid to the environment. No direct relationship between paper mill injection activities and the original release has been established. EPA determined that no significant risk or threat to public health and the environment exists and therefore no further action will be taken at this site. There are no implementation issues or costs associated with this no action remedy.

28234 **(PB—88-173000/XAB) Superfund record of decision (EPA Region 7): Minker/Stout/Romaine Creek site, Romaine Creek portion, Jefferson County, Missouri (second remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 28 Sep 1987. 21p. (EPA/ROD/R—07-87/007). NTIS, PC A03/MF A01.

The Romaine Creek portion of the Minker/Stout/Romaine Creek site is located in Jefferson County, Missouri, approximately 20 miles southwest of St. Louis. Romaine Creek starts at the Minker area and flows 4.6 miles to its confluence with Saline Creek. Romaine Creek is located in a rural residential area, and is not used for municipal, industrial, or domestic purposes. In the late 1960s and early 1970s, a southwest Missouri chemical plant producing 2,4,5-T and hexachlorophene contracted a waste-oil reclaimer to remove process residues. The residues, contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) were mixed with waste oils and sprayed as a dust suppressant on a nearby horse arena. In March of 1973, the owner of the horse arena had the contaminated soils removed to various portions of the Minker/Stout/Romaine Creek site. Approximately 120 cu yds of the soil was used as fill in a ravine on the Minker property, and since 1973, much has eroded into Romaine Creek. In 1982, contaminated soils above 1 ug/kg TCDD were excavated from the Minker portion of the site. The primary contaminant of concern is dioxin.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5302 Assessment Of Energy Technologies

28235 **(EIS—87-0419(Final)) Potential exploration, development, and production of oil and gas resources, Vandenberg Air Force Base, California.** (Strategic Air Command, Vandenberg AFB, CA (USA)). Dec 1987. vp. Cambridge Scientific Abstracts, 7200 Wisconsin Ave., 6th Floor, Bethesda, MD 20814.

EPA No. 870448F; AF.

Adoption of a mineral resource management plan on Vandenberg Air Force Base (VAFB) in California is proposed. The purpose of the plan is to provide for gas and oil resources exploration, development, and production on VAFB, while minimizing conflicts with Air Force missions and damage to the local and regional environments. Oil and gas development on VAFB would benefit the local economy through creation of jobs and income. Approximately 125 direct jobs could be created under a feasible development scenario. Development could adversely affect the base's mission. The geologic environment of VAFB would be affected by petroleum operations due to construction of access roads, pipelines, well pads, and associated facilities. Using projections of likely oil and gas demands, a one-time use of 450 acre-feet for well drilling and cyclic steam demand of 1000 acre-feet per year for 100 wells would cause further drawdown of an already overdrawn aquifer. This drawdown could impact the water supplies of VAFB and other basin users, as well as aquatic and biologically dependent species of Barka Slough and San Antonio Creek. Significant impacts on water quality could occur from an oil or gas spill or similar accident, and air quality impacts could also result. Several sensitive biological resources could be affected by oil and gas extraction.

28236 **(EIS—87-0422(Final)) Colmac biomass-fueled power plant, Cabazon Indian Reservation, Riverside County, California.** (Bureau of Indian Affairs, Sacramento, CA (USA)). Nov 1987. 670p. Cambridge Scientific Abstracts, 7200 Wisconsin Ave., 6th Floor, Bethesda, MD 20814.

EPA No. 870432F; DOI.

Approval of a lease agreement between the Cabazon Band of Mission Indians (Cabazon) and Colmac Energy, Inc. (Colmac) is proposed pursuant to the Cabazon tribal resolution to allow for the construction and operation of a 45-MW biomass-fueled electrical power plant and related facilities on Indian reservation lands in Riverside County, California. The plant would be located one mile northwest of Mecca. Facilities to be constructed in relation to the plant would include a fuel-receiving area, fuel storage area, fuel reclaimer and boiler feed system, power generation area, administration building, and 200,000-gallon water storage tank to provide for fire protection and process makeup water. The plant would convert approximately 400,000 wet tons of truck-delivered biomass per year. Operation of the plant would represent a significant focus for economic development for the Cabazon Tribe, diversifying the economic capabilities of the reservation and yielding long-term economic returns from a section of the reservation that has long been dormant. Dependence on nonrenewable fuels would be reduced, and woody waste materials would be used productively, lessening burdens on local landfills. Thirty-three full-time employees would be required for operation of the plant. Power plant operations would generate additional offsite jobs, particularly for truck drivers. Emissions from the plant would cause minor decreases in ozone concentrations within 10 to 20 miles of the site, and short-lived minor increases at greater distances. Plant operations and trucks would generate noise. Pressure valves could generate high-frequency sound of an intermittent nature.

28237 **(EIS—87-0423(Final)) Mojave-Kern River-El Dorado natural gas pipeline projects, California.** (USDOE Federal Energy Regulatory Commission, Washington, DC). Dec 1987. vp. (FERC/FEIS—0045). Cambridge Scientific Abstracts, 7200 Wisconsin Ave., 6th Floor, Bethesda, MD 20814.

EPA No. 870447F; DOE.

Pipeline projects to transport natural gas supplies from various sources outside of California to the Bakersfield, California area for use in enhanced oil recovery and related cogeneration projects are proposed. The primary projects are proposed by Mojave Pipeline Company, Kern River Gas Transmission Company, and El Dorado Interstate Transmission Company. In each case, producers of crude oil in the San Joaquin Valley would use the natural gas as boiler fuel to create steam, which would be injected into the oil fields to produce crude oil not recoverable by primary methods. The proposed projects would allow substitution of natural gas for the crude oil now used and could allow entry into the market of producers who presently cannot obtain authority to burn oil due to air pollution restrictions. Loss of wetland and riparian vegetation, wildlife habitat, and endangered species and their special habitat could occur. Potentially significant cultural resources and their research potential could be permanently destroyed. Construction and operation of the pipeline facilities would result in the loss of pristine visual environment and degradation of established visual resources. The probability of significant wind erosion would be high, with significant intensive surface runoff increasing sediment load and decreasing water quality in many areas.

28238 **(EIS—87-0424(Draft)) Proposed offshore oil and gas lease Sale 91, Northern California.** (Minerals Management Service, Los Angeles, CA (USA). Pacific OCS Region). Dec 1987. vp. (OCS-EIS/EA-MMSA—87-0032). Cambridge Scientific Abstracts, 7200 Wisconsin Ave., 6th Floor, Bethesda, MD 20814.

EPA No. 870439D; DOI.

Leasing of 223 whole and partial oil and gas development blocks encompassing 1.1 million acres offshore of Humboldt and Mendocino counties, California is proposed. The areas to be leased, known as the Eel River Basin and the Point Arena Basin, lie 3 to 27 miles offshore in water depths ranging from 30 to 1850 meters (100 to 6070 feet). The lands represent approximately 4% of the total acreage in the Northern California Outer Continental Shelf Planning Area and approximately 41% of the available acreage identified in the five-year OCS Leasing Program for the Northern California Planning Area. Development of hydrocarbon resources in the Eel River and Point Arena basins would provide domestic oil for the US, thereby decreasing the nation's dependency on foreign sources of oil and gas. Employment and other economic indicators would increase in the region affected by lease development. Sediment suspension from sea floor activities, discharge of drilling muds, increases in hydrocarbon loading, formation water discharges, and sewage discharges would degrade ambient water quality in the lease areas. Minor alterations in subtidal benthic communities would occur in the vicinity of exploratory vessels and production platforms and pipeline laying corridors. It is assumed that 1.44 spills of 1000 barrels of oil or more could impact marine mammals and marine and coastal birds. Brown pelicans, gray whales, and humpback whales, all of which are endangered, could be affected by significant oil spills. Seismic and drilling noises would affect cetaceans. Commercial fishing would suffer low to moderate impacts, resulting in a 10 to 20% in income for this sector.

28239 **Error propagation for large errors.** Seiler, F.A. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (USA)). *Risk Analysis;* 7: No. 4, 509-518(Dec 1987).

An essential facet of a risk assessment is the correct evaluation of uncertainties inherent in the numerical results. If the calculation is based on an explicit algebraic expression, an analytical treatment of error propagation is possible, usually as an approximation valid for small errors. In many instances, however, the errors are large and uncertain. It is the purpose of this paper to demonstrate that despite large errors, an analytical treatment is possible in many instances. These cases can be identified by an analysis of the algebraic structure and a detailed examination of the errors in input parameters and mathematical models. From a general formula, explicit formulas for some simple algebraic structures that occur often in risk assessments are derived and applied to practical problems.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 27551, 27559, 27562, 27563, 28263, 28278, 28281

28240 **Nucleotide sequence of the hexA gene for DNA mismatch repair in Streptococcus pneumoniae and homology of hexA to mutS of Escherichia coli and Salmonella typhimurium.** Priebe, S.D.; Hadi, S.M.; Greenberg, B.; Lacks, S.A. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Bacteriology;* **170**: No. 1, 190-196(Jan 1988).

The Hex system of heteroduplex DNA base mismatch repair operates in Streptococcus pneumoniae after transformation and replication to correct donor and nascent DNA strands, respectively. A functionally similar system, called Mut, operates in Escherichia coli and Salmonella typhimurium. The nucleotide sequence of a 3.8-kilobase segment from the S. pneumoniae chromosome that includes the 2.7-kilobase hexA gene was determined. Chromosomal DNA used as donor to measure Hex phenotype was irradiated with UV light. An open reading frame that could encode a 17-kilodalton polypeptide (OrfC) was located just upstream of the gene encoding a polypeptide of 95 kilodaltons corresponding to HexA. Shine-Dalgarno sequences and putative promoters were identified upstream of each protein start site. Insertion mutations showed that only HexA functioned in mismatch repair and that the promoter for hexA transcription was located within the OrfC-coding region. The HexA polypeptide contains a consensus sequence for ATP- or GTP-binding sites in proteins. Comparison of the entire HexA protein sequence to that of MutS of S. typhimurium, showed the proteins to be homologous, inasmuch as 36% of their amino acid residues were identical. This homology indicates that the Hex and Mut systems of mismatch repair evolved from an ancestor common to the gram-positive streptococci and the gram-negative enterobacteria. It is the first direct evidence linking the two systems.

28241 **Cloning of the Bacillus subtilis recE$^+$ gene and functional expression of recE$^+$ in B. subtilis.** Marrero, R.; Yasbin, R.E. (Univ. of Rochester School of Medicine and Dentistry, NY). *Journal of Bacteriology;* **170**: No. 1, 335-344(Jan 1988). Contract AC02-81ER60017.

By use of the Bacillus subtilis bacteriophage cloning vehicle Phi 105J23, B. subtilis chromosomal MboI fragments have been cloned that alleviate the pleiotropic effects of the recE4 mutation. The recombinant bacteriophages Phi 105Rec Phi1 (3.85-kilobase insert) and Phi 105Rec Phi4 (3.3-kilobase insert) both conferred on the recE4 strain YB1015 resistance to ethylmethane sulfonate, methylmethane sulfonate, mitomycin C, and UV irradiation comparable with the resistance observed in recE$^+$ strains. While strain YB1015 (recE4) and its derivatives lysogenized with bacteriophage Phi105J23 were not transformed to prototrophy by B. subtilis chromosomal DNA, strain YB1015 lysogenized with either Phi 105Rec Phi 1 or Phi 105RecPhi 4 was susceptible to transformation with homologous B. subtilis chromosomal DNA. The heteroimmune prophages Phi 105 and SPO2 were essentially uninducible in strain YB1015. Significantly, both recombinant prophages Phi 105RecPhi 1 and Phi 105Rec Phi 4 were fully inducible and allowed the spontaneous and mitomycin C-dependent induction of a coresident SPO2 prophage in a recE4 host. The presence of the recombinant prophages also restored the ability of din genes to be induced in strains carrying the recE4 mutation. Finally, both recombinant bacteriophages elaborated a mitomycin C-inducible, 45-kilodalton protein that was immunoreactive with Escherichia coli recA$^+$ gene product antibodies. Collectively, these data demonstrate that the recE$^+$ gene has been cloned and that this gene elaborates the 45-kilodalton protein that is involved in SOB induction and homologous recombination.

28242 **Cloning and sequencing of the genes encoding the large and small subunits of the periplasmic (NiFeSe) hydrogenase of Desulfovibrio baculatus.** Menon, N.K.; Peck, H.D. Jr.; Le Gall, J.; Przybyla, A.E. (Univ. of Georgia, Athens). *Journal of Bacteriology;* **169**: No. 12, 5401-5407(Dec 1987).

The genes coding for the large and small subunits of the periplasmic hydrogenase from Desulfovibrio baculatus have been cloned and sequenced. The genes are arranged in an operon with the small subunit gene preceding the large subunit gene. The small subunit gene codes for a 32 amino acid leader sequence supporting the periplasmic localization of the protein, however no ferredoxin-like or other characteristic iron-sulfur coordination sites were observed. The periplasmic hydrogenases from D. baculatus (an NiFeSe protein) and D. vulgaris (an Fe protein) exhibit no homology suggesting that they are structurally different, unrelated entities.

28243 **Glyceraldehyde-3-phosphate dehydrogenase gene from Zymomonas mobilis: cloning, sequencing, and identification of promoter region.** Conway, T.; Sewell, G.W.; Ingram, L.O. (Univ. of Florida, Gainesville). *Journal of Bacteriology;* **169**: No. 12, 5653-5662(Dec 1987). Contract FG05-86ER13575.

The gene encoding glyceraldehyde-3-phosphate dehydrogenase was isolated from a library of Zymomonas mobilis DNA fragments by complementing a deficient strain of Escherichia coli. It contained tandem promoters which were recognized by E. coli but appeared to function less efficiently than the enteric lac promoter in E. coli. The open reading frame for this gene encoded 337 amino acids with an aggregate molecular weight of 36,099 (including the N-terminal methionine). The primary amino acid sequence for this gene had considerable functional homology and amino acid identity with other eukaryotic and bacterial genes. Based on this comparison, the gap gene from Z. mobilis appeared to be most closely related to that of the thermophilic bacteria and to the chloroplast isozymes. Comparison of this gene with other glycolytic enzymes from Z. mobilis revealed a conserved pattern of codon bias and several common features of gene structure. A tentative transcriptional consensus sequence is proposed for Z. mobilis based on comparison of the five known promoters for three glycolytic enzymes.

28244 **Pseudomonas stutzeri outer membrane proteins inserts copper into N_2O reductase.** Mokhele, K.; Tang, Y.J.; Clark, M.A.; Ingraham, J.L. (Univ. of California, Davis). *Journal of Bacteriology;* **169**: No. 12, 5721-5726(Dec 1987). Contract FG03-85ER13356.

Among a set of frameshift mutagen (ICR-191; Polysciences, Inc.)-induced mutations that confer inability to grown anaerobically with N_2O as the sole electron acceptor, one class was found that produced an inactive N_2O reductase which lacked copper. All of these mutant strains failed to produce a 61,000-M/sub r/ protein located in the outer membrane. This protein, termed NosA, seems not to be responsible for bringing copper into the cell because the mutant strains and their parent were similarly sensitive to the copper content of the growth medium and no intermediate copper concentration in the medium permitted the mutant strains (nosA) to grow anaerobically with N_2O as the sole electron acceptor. We conclude that NosA is necessary to insert copper into N_2O reductase or to maintain it there.

28245 **Differential transcription of the two glutamine synthetase gene of Bradyrhizobium japonicum.** Carlson, T.A.; Martin, G.B.; Chelm, B.K. (Michigan State Univ., East Lansing). *Journal of Bacteriology;* **169**: No. 12, 5861-5866(Dec 1987).

Bradyrhizobium japonicum induces the formation of nitrogen-fixing symbiotic root nodules on soybean plants. The B. japonicum genome encodes two isoforms of glutamine synthetase (GS). One form, GSI, encoded by the gene glnA, is similar in structure and activity to the enzyme found in all other bacteria. The second form, GSII, encoded by glnII, is structurally related to the eukaryotic enzyme. Genetic analyses indicate that glnA or glnII alone is sufficient to provide glutamine prototrophy, whereas the double mutation glnA glnII produces glutamine auxotrophy. The glnA gene is transcribed from a single promoter that has a structure most similar to that of the bacterial consensus promoter. The level of transcription of glnA is not specifically affected by nitrogen limitation of growth. The glnII gene is also transcribed from a single promoter; however, this promoter has structural features characteristic of promoters controlled by the nitrogen regulation system. In

contrast to glnA, physiological studies indicate that glnII transcription is regulated in response to nitrogen source availability. Under aerobic growth conditions, expression of glnII is induced when growth is limited by nitrogen source depletion as expected for regulation by the nitrogen regulation system.

28246 **Structure and organization of the hisA gene of the Thermophilic archaebacterium Methanococcus thermolithotrophicus.** Weil, C.F.; Beckler, G.S.; Reeve, J.N. (Ohio State Univ., Columbus (USA)). *Journal of Bacteriology;* **169**: No. 10, 4857-4860(Oct 1987). Contract AC02-81ER10945.

A restriction fragment of Methanococcus thermolithotrophicus genomic DNA was cloned into pUC8 to produce plasmid pET9301, which complements mutations in the hisA gene of Escherichia coli. Sequencing the DNA (2155 base pairs) cloned from this thermophilic methanogen demonstrated that the M. thermolithotrophicus hisA gene is located within a cluster of open reading frames (ORFs) and is 68 and 69% homologous at the nucleotide level to the hisA genes of the mesophilic methanococci M. voltae and M. vannielii, respectively. The ORF (ORF 206) immediately 5′ to the hisA gene of M. thermolithotrophicus is partially deleted in the genomes of the two mesophilic species, whereas ORF 114, which is 5′ to ORF 206, is conserved in all three species.

5503 Cytology

REFER ALSO TO CITATION(S) 28297

28247 **Variation in precursor pool size during the division cycle of Escherichia coli: further evidence for linear cell growth.** Kubitschek, H.E.; Pai, S.R. (Argonne National Lab., IL). *Journal of Bacteriology;* **170**: No. 1, 431-435(Jan 1988). Contract W-31-109-ENG-38.

The magnitudes of several pools of radioactively labeled precursors for RNA and protein synthesis were determined as a function of cell age during the division cycle of Escherichia coli 15 THU. Uracil, histidine, and methionine pools increased from low initial values for cells at birth to maxima during midcycle and then subsided again. These pools were small or nonexistent at the beginning and the end of the cycle, and their average values during the cycle were less that 4% of the total cellular radioactivity. The results are consistent with a linear pattern of growth for cells during the division cycle and provide strong evidence against exponential or bilinear growth of E. coli cells.

5504 Genetics

REFER ALSO TO CITATION(S) 28241, 28245

28248 **Genetic and physical analyses of Methylobacterium organophilum XX genes encoding methanol oxidation.** Machlin, S.M.; Tam, P.E.; Bastien, C.A.; Hanson, R.S. (Univ. of Minnesota, Navarre). *Journal of Bacteriology;* **170**: No. 1, 141-148(Jan 1988). Contract AC02-82ER12029.

When allyl alcohol was used as a suicide substrate, spontaneous mutants and UV light- and nitrous acid-generated mutants of Methylobacterium organophilum XX were selected which grew on methylamine but not on methanol. There was no detectable methanol dehydrogenase (MDH) activity in crude extracts of these mutants, yet Western blots revealed that some mutants still produced MDH protein. Complementation of 50 mutants by a cosmid gene bank of M. organophilum XX demonstrated that three major regions of the genome, each of which was separated by a minimum of 40 kilobases, were required for expression of active MDH. By subcloning and Tn5 insertion mutagenesis of subcloned fragments, at least 11 genes clustered within these three regions were subsequently identified. The identity of the MDH structural gene, which was initially determined by hybridization to the structural gene of Methylobacterium sp. strain AM1, was confirmed by Western blot analysis of an MDH-β-galactosidase fusion protein.

5505 Metabolism

REFER ALSO TO CITATION(S) 28292

28249 **Environmental factors affecting indole metabolism under anaerobic conditions.** Madsen, E.L.; Francis, A.J.; Bollag, J.M. (Pennsylvania State Univ., University Park). *Applied and Environmental Microbiology;* **54**: No. 1, 74-78(Jan 1988). Contract FG02-87ER60556.

The influence of physiological and environmental factors on the accumulation of oxindole during anaerobic indole metabolism was investigated by high-performance liquid chromatography. Under methanogenic conditions, indole was temporarily converted to oxindole in stoichiometric amounts in media inoculated with three freshwater sediments and an organic soil. In media inoculated with methanogenic sewage sludge, the modest amounts of oxindole detected at 35°C reached higher concentrations and persisted longer when the incubation temperature was decreased from 35 to 15°C. Also, decreasing the concentration of sewage sludge used as an inoculum from 50 to 1% caused an increase in the accumulation of oxindole from 10 to 75% of the indole added. Under denitrifying conditions, regardless of the concentration or source of the inoculum, oxindole appeared in trace amounts but did not accumulate during indole metabolism. In addition, denitrifying consortia which previously metabolized indole degraded oxindole with no lag period. Our data suggest that oxindole accumulation under methanogenic, but not under denitrifying conditions is caused by differences between relative rates of oxindole production and destruction.

28250 **Catabolic enzyme of the acetogen Butyribacterium methylotrophicum grown on single-carbon substrates.** Kerby, R.; Zeikus, J.G. (Univ. of Wisconsin, Madison). *Journal of Bacteriology;* **169**: No. 12, 5605-5609(Dec 1987).

When grown on formate, formate-CO, and methanol-CO, Butyribacterium methylotrophicum contained high levels of tetrahydrofolate (H_4folate) and required enzymes, carbon monoxide dehydrogenase, formate dehydrogenase, and hydrogenase. The activities of methylene-H_4folate reductase were comparable to other H_4folate activities (which ranged from 0.55 to 9.28 μmol/min per mg of protein) when measured by an improved radioisotopic assay. The H_4folate activities in formate-grown cells were twice those found in formate-CO-grown cells. This result correlated with a growth yield on formate that was one-half that on formate-CO. The stoichiometry of the formyl-H_4folate synthetase reaction was 1 mol of ATP per 1 mol of formate. The methylene-H_4folate dehydrogenase was NAD^+ dependent. We conclude that B. methylotrophicum utilizes these enzymes in homoacetogenic catabolism.

28251 **Carbon monoxide-driven electron transport in Clostridium thermoautotrophicum membranes.** Hugenholtz, J.; Ivey, D.M.; Ljungdahl, L.G. (Univ. of Georgia, Athens). *Journal of Bacteriology;* **169**: No. 12, 5845-5847(Dec 1987). Contract AS09-79ER10499.

Membrane vesicles of Clostridium thermoautotrophicum prepared by osmotic lysis after lysozyme treatment contained carbon monoxide dehydrogenase and methylenetetrahydrofolate dehydrogenase with specific activities three- to fourfold higher than the specific activity of the cytoplasm. The membrane-associated carbon monoxide dehydrogenase mediated the reduction with CO or the oxidation with CO_2 of b-type cytochromes and other carriers in the membrane.

5506 Medicine

REFER ALSO TO CITATION(S) 27607, 27992, 27993, 27994, 27995, 27996, 28006, 28033, 28280, 28651

28252 (INIS-BR—963, pp 85-86) **Abdominal actinomycosis.** Oliveira, J.N. de; Oliveira, L.A.N. de; Gomes, R.M.A. (Hospital do Servidor Publico Estadual de Sao Paulo (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701617/JAW. (CONF-8710295—).

From 21. Brazilian Congress of Radiology; Sao Paulo, SP, Brazil (10 Oct 1987).

28253 (INIS-BR—963, pp 137-138) **Comparison between myocardic scintingraphy with thallium 201- and venous dipyramidol, with ergometric test and coronariography in early prognostic evaluation after acute myocardial infarction.** Fonseca, L.M.B. da; Pantoja, M.; Nacife, L.A. (Rio de Janeiro Univ. (Brazil). Hospital Universitario; Hospital dos Servidores do Estado, Rio de Janeiro (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701617/JAW. (CONF-8710295—).

From 21. Brazilian Congress of Radiology; Sao Paulo, SP, Brazil (10 Oct 1987).

28254 (INIS-BR—963, pp 207-208) **Radiologic evaluation of neoplasms of the liver.** Wallace, S.; Charansangaverj, C.; Carrasco, C.H.; Richli, W. 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701617/JAW. (CONF-8710295—).

From 21. Brazilian Congress of Radiology; Sao Paulo, SP, Brazil (10 Oct 1987).

28255 (INIS-BR—963, pp 229) **Brain and spinal cord MR imaging in paediatric patients.** Coppola, V.; Verrengia, D.; La Tessa, G.; Smattino, F. 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701617/JAW. (CONF-8710295—).

From 21. Brazilian Congress of Radiology; Sao Paulo, SP, Brazil (10 Oct 1987).

28256 (INIS-BR—1039) **Evaluation of the radiographic process using a experimental monobath solution compared with normal (Kodak) and rapid (RAY) developer solutions.** Baratieri, N.M.M. (Sao Paulo Univ., Bauru (Brazil). Faculdade de Odontologia). 1985. 157p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702303/JAW.

A comparative evaluation of the radiographic image quality of two dental X-ray films (Kodak's EP-21 and Agfa-Gevaert DOS-1) when processed in a normal (Kodak) a rapid (Ray) and a experimental monobath solutions, is presented. These films, processed in those solutions had their time of development, temperature and agitation performances checked by sensitometry; pH and color by routine methods and hipo rests by spectrophotometry. The radiographies were also analysed by able professionals regarding the best development time. The data so obtained allowed the conclusions that the best development time for the monobath was 3 minutes at 20/sup 0/C but 25 or 30/sup 0/C give also acceptable results at shorter times. The agitation of 10 seconds every minute is an important factor concerning image quality. pH and color do alter rapidally but with little influence in the final result. We found a certain amount of residual chemical compounds which were not identified but that are not hipo components, and being important to note that they seem not act upon the emulsion at least during one year after processing.

28257 (INIS-BR—1042) **Analysis of the variations in exposure and development time on KODAK EKTASPEED (EP-21) and AGFA-GEVAERT (DOS-1) periapical radiografic films.** Pinho, M.B. de. (Sao Paulo Univ., Bauru (Brazil). Faculdade de Odontologia). 1984. 110p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702306/JAW.

The effects of the changes in the exposure and development time, on the Kodak EP-21 and Agfa-Gevaert periapical radiographic films, when processed on the Kodak Dental X-Ray Developer at 20/sup 0/C, are evaluated. The methods used the characteristic curve and sensitometric properties, an evaluation of the optical densities of a steep wedge radiographs and a subjective analysis. The results obtained from the different exposures and development combinations have been shown that the optical densities of the Ektaspeed films are greater than the Agfa-Gevaert films, except for the over exposed ones, which are similar. When processed under the same conditions, the characteristic curves presented the same form, ans as far as the sensitometric properties are concerned the Ektaspeed film showed a higher sensibility. The steep-wedge radiographs have been shown that both films answered better to the development changes when correctly exposed.

28258 (INIS-mf—11201) **Detection of elliptical contours. An application in the field of quantitative nuclear cardiology.** Blokland, J.A.K. (Rijksuniversiteit Leiden (Netherlands)). 7 Oct 1987. 158p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702378/JAW.

Contains summary in Dutch.

This dissertation describes the quantitation of myocardial perfusion defects in planar thallium-201 scintigrams. To be able to quantify the distribution of /sup 201/Tl in the myocardium as imaged by the scintigram, accurate delineation of the target object is a prerequisite. The distribution of the radionuclide within the contour of the left ventricle can be described by application of circumferential profiles. By comparing the computed circumferential profile with those of normal subjects, humans with no evidence of coronary artery disease, segments of the left ventricle with decreased bloodflow can be detected. In practice there is no real standard to compare with, and due to noise and biological variations, it is not always possible to make a definite decision regarding the presence of a defect in the distribution of the radionuclide. The value and limitations of the developed quantification procedure are discussed. Some future developments are suggested. 108 refs.; 57 figs.; 5 tabs.

28259 (INIS-mf—11208) **/sup 99m/Tc bone scanning agents preparation and chemical analysis of Tc(Sn)pyrophosphate, Tc(Sn)MDP and Tc(Sn)HMDP.** Kroesbergen, J. (Rijksuniversiteit Utrecht (Netherlands)). 17 Mar 1986. 177p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702385/JAW.

Contains summary in Dutch and previously published material.

This thesis describes a comparison of the preparation, composition and properties of three bone scanning agents: /sup 99m/Tc(Sn)pyrophosphate, /sup 99m/Tc(Sn)MDP and /sup 99m/Tc(Sn)HMDP. This study has been performed for two reasons: First to investigate the preparation and composition of the radiopharmaceuticals as a function of experimental conditions. Together with previously reported results for /sup 99m/Tc(Sn)EHDP, obtained in a similar way, this enables to use well-defined preparations of the bone scanning agents. Secondly to gain an insight in the mechanism in which the agents behave 'in vivo'. Because the 'in vivo' process is too complicated to study directly, it seemed more appropriate to perform 'in vitro' investigations as simplifications of the 'in vivo' situation. 304 refs.; 26 figs.; 31 tabs.

28260 (PB—88-858782/XAB) **Computerized tomography: technology and equipment. January 1977-February 1988 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1977-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 185p. NTIS PC N01/MF N01.

Supersedes PB—86-870862.

This bibliography contains citations concerning recent developments in the instrumentation, technology, and applications of computerized tomography (CT). Production model CT scanners are compared and evaluated for noise, spatial resolution, axial-position sensitivity, artifact, and dose. Research and development efforts on new equipment and applications are discussed. (This updated bibliography contains 377 citations, 50 of which are new entries to the previous edition.)

28261 **Differences in the solution structures of oxidized and reduced cytochrome c measured by small-angle X-ray scattering.** Trewhella, J.; Carlson, V.A.P.; Curtis, E.H.; Heidorn, D.B. (Los Alamos National Lab., NM (USA)). *Biochemistry;* **27**: No. 4, 1121-1125(23 Feb 1988).

While X-ray crystallographic data on cytochrome c show the reduced and oxidized forms to have very similar structures, there is a considerable body of data, mostly from solution studies, that indicates the reduced form is more stable and that the interior of the protein is less accessible to solvent in this state. These obser-

vations have led to the hypothesis that while the time-averaged structure is preserved between the two forms, the dynamics of the two forms are different. The oxidized form has been proposed to undergo more large-amplitude, low-frequency motions than the reduced form. The crystal structure data were derived from crystals grown in high salt concentrations, but the solution studies were done at relatively low ionic strength. Small-angle X-ray scattering has been used to examine the effects of the ionic strength and oxidation state on the solution structure of cytochrome c. The authors find that the radius of gyration and the maximum linear dimension of oxidized cytochrome c are significantly larger than those for reduced cytochrome c, in 5 mM phosphate buffer at pH 7.3, and further that this difference is suppressed by addition of 200 mM sodium chloride. They conclude that there is a real structural difference between the two forms at low ionic strength in solution and that this difference is likely to contribute to the observed differences in accessibility and compressibility.

28262 Radiobrominated m-tyrosine analog as potential CNS L-dopa PET tracer. De Jesus, O.T.; Mukherjee, J. (Argonne National Lab., IL (USA)). *Biochemical and Biophysical Research Communications;* **150**: No. 3, 1027-1031(15 Feb 1988).

Radiobrominated 6-bromo-m-tyrosine (6-BMT) was prepared and the time course of its localization in selected cerebral and peripheral organs in the mouse was determined. Since m-tyrosine is known to have L-dopa-like properties in vivo, our goal was to assess the utility of a radiolabeled analog as a tracer for cerebral L-dopa. Our preliminary results showed that substantial amounts of 6-BMT is extracted by the mouse brain and that the regional distribution and time course of the radiotracer is consistent with uptake in regions rich in dopamine neurons. Although a more thorough biochemical characterization of 6-BMT is necessary, this or other positron emitting analogs of m-tyrosine, such as an ^{18}F labelled analog, may be useful PET tracers for the non-invasive study of dopamine turnover in humans.

28263 Comparison of the crystal and solution structures of calmodulin and troponin C. Heidorn, D.B.; Trewhella, J. (Los Alamos National Lab., NM (USA)). *Biochemistry;* **27**: No. 3, 909-915(9 Feb 1988).

X-ray solution scattering data from skeletal muscle troponin C and from calmodulin have been measured. Modeling studies based on the crystal structure coordinates for these proteins show discrepancies between the solution data and the crystal structure that indicate that if the size and shape of the globular domains are the same in solution as in the crystal, the distances between them must be smaller by several angstroms. Bringing the globular domains closer together requires structural changes in the interconnecting helix that joins them.

28264 Raman spectroscopic study of left-handed Z-RNA. Trulson, M.O.; Cruz, P.; Puglisi, J.D.; Tinoco, I. Jr.; Mathies, R.A. (Univ. of California, Berkeley (USA)). *Biochemistry;* **26**: No. 26, 8624-8630(29 Dec 1987). Contract FG03-86ER60406.

The solvent conditions that induce the formation of a left-handed Z form of poly[r(G-C)] have been extended to include 6.5 M NaBr at 35°C and 3.8 M $MgCl_2$ at room temperature. The analysis of the A → Z transition in RNA by circular dichroism (CD), ^1H and ^{31}P NMR, and Raman spectroscopy shows that two distinct forms of left-handed RNA exist. The Z/sub R/-RNA structure forms in high concentrations of NaBr and $NaClO_4$ and exhibits a unique CD signature. Z/sub D/-RNA is found in concentrated $MgCl_2$ and has a CD signature similar to the Z form of poly[d(G-C)]. Significant differences in the glycosyl angle and sugar pucker between Z-DNA and Z-RNA are suggested by the 16-cm^{-1} difference in the position of this band. The Raman evidence for structural difference between Z/sub D/- and Z/sub R/-RNA comes from two groups of bands: First, Raman intensities between 1180 and 1600 cm^{-1} of Z/sub D/-RNA differ from those for Z/sub R/-RNA, corroborating the CD evidence for differences in base-stacking geometry. Second, the phosphodiester stretching bands near 815 cm^{-1} provide evidence of differences in backbone geometry between Z/sub D-/ and Z/sub R/-RNA.

5507 Microbiology

REFER ALSO TO CITATION(S) 27548, 27549, 27563, 28241, 28243, 28250, 28281

28265 Adaptation for growth at various saline concentrations by the archaebacterium Methanosarcina thermophila. Sowers, K.R.; Gunsalus, R.P. (Univ. of California, Los Angeles). *Journal of Bacteriology;* **170**: No. 2, 998-1002(Feb 1988).

The authors report the ability of Mesthanosarcina thermophila TM-1 to adapt and grow in media containing NaCl concentrations of 0.005 to 1.2 M. When adapted to marine NaCl concentrations, this species ceased to produce the heteropolysaccharide outer layer typically formed by species of nonmarine origin. Concomitant with this adaptation, M. thermophila ceased to grow as multicellular aggregates and existed solely in single-cell form. The sodium ion concentration was critical for the adaptation process, although magnesium ion appeared to contribute to the cell wall stability of single cells. The results suggest that these archaebacteria possess regulatory systems that enable them to adapt to environments with a wide range of saline concentrations.

28266 Quantitative immunologic analysis of the methanogenic flora of digestors reveals a considerable diversity. Macario, A.J.L.; de Macario, E.C. (State Univ. of New York, Albany). *Applied and Environmental Microbiology;* **54**: No. 1, 79-86(Jan 1988). Contract FG02-84ER13197.

To determine which methanogens occur in digestors, we performed a quantitative immunologic analysis of a variety of samples. A comprehensive panel of calibrated polyclonal antibody probes of predefined specificity spectra was used. This allowed precise identification of bacteria by antigenic fingerprinting. A considerable diversity of methanogens was uncovered, much larger than previously reported, encompassing at least 14 strains of 11 species. Strategies were developed to measure the load of any given methanogen in a sample and to compare samples quantitatively. Two methanogens were found to predominate which were antigenically closely related with either Methanobacterium formicicum MF or Methanobrevibacter arboriphilus AZ. Fundamental data, probes, and methods are now available to monitor methanogenic subpopulations during digestor operation and thus learn about their respective roles and predictive and predictive significance.

5509 Pathology

REFER ALSO TO CITATION(S) 27670, 28214, 28285, 28286, 28288, 28289

28267 (AD-A—187949/3/XAB) Toxic effects of man-made mineral fibers with particular reference to ceramic fibers. Technical report, December 1986-January 1987. Vinegar, A. (Northrop Services, Inc./Environmental Sciences, Dayton, OH (USA)). Sep 1987. 33p. NTIS, PC A03/MF A01.

In order to evaluate the potential hazards of man-made mineral fibers (MMMF): particularly ceramic fibers in the Navy work environment, the following areas are considered. First, the current standards and recommendations of other agencies are presented as an overview of current consensus as to relative hazards of asbestos, MMMF, and cristobalite (a form of crystalline silica). Then, a summary of recent epidemiological evidence is presented. These data should be the most relevant for human exposure. Unfortunately, there are no data for workers in the ceramic-fiber field. Then a review is presented of the data from animal experiments which employed exposure by inhalation, intratracheal instillation, and intrapleural or intraperitoneal injection. The experiments reviewed involve only non-ceramic MMMF. Some detail of the protocol and results of each experiment are presented to provide a better understanding of the non-uniformity of the protocols used. Another issue of particular importance in understanding fiber toxicity is the durability of the fiber. These data are presented for non ceramic MMMF.

28268 (AD-A—188285/1/XAB) Studies of the action of chemical agents on the heart. Annual report, February 1985-February 1986. Hassler, G.R.; Moutvic, R.R. (Battelle Columbus Labs., OH (USA)). Mar 1986. 36p. NTIS, PC A03/MF A01.

This report describes initial studies to determine the subchronic effect of Soman and Sarin, on the electrical, mechanical, and neurochemical properties of the heart. Two different animal models are under development. The electrophysiologic and hemodynamic aspects of survival doses of chemical agent are begin studied in the dog. Two chronically instrumented dog models have been developed. The first is a hemodynamic dog model in which long-term measurements of left and right heart pressures, aortic flow, coronary flow as well as epicardial electrocardiograms, are monitored. The animals will be monitored at baseline and for one month following exposure in survival of a chemical-warfare-agent insult. These animals are stressed via treadmill exercise. The electrophysiology dog model consists of chronically implanted electrodes for performance of repetitive ventricular response stimulation, His bundle recording, and ECG analysis. Measurements are made prior to, and for one month following, exposure to survivable doses of CW agent. This dog model is further probed by sequential administration of various pharmacologic agents designed to study the autonomic status of the heart. All dogs and a limited number of the guinea pigs will be continuously monitored for occurrence of arrhythmic events utilizing Holter monitoring technology. The guinea pig neurochemical studies will include acetylcholines, choline acetyltransferase activity, QNB binding, choline uptake, norepinephrine levels and turnover, and norepinephrine uptake experiments.

28269 (PB—88-860127/XAB) Toxicity of manganese. January 1970-March 1988 (Citations from the NTIS data base). Report for January 1970-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 121p. NTIS PC N01/MF N01.

Supersedes PB—85-864593.

This bibliography contains citations concerning the toxicity, carcinogenicity, environmental pollution, and other hazards and adverse effects of manganese. The detection, characterization, analytical methods, standards, and removal from the environment are considered. These aspects of manganese are dealt with in relation to aquatic and terrestrial flora and fauna, including man. Manganese pollution from mining operations is also discussed. (This updated bibliography contains 225 citations, 35 of which are new entries to the previous edition.)

28270 (PB—88-860283/XAB) Toxicity of nickel. January 1970-March 1988 (Citations from the NTIS data base). Report for January 1970-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 150p. NTIS PC N01/MF N01.

Supersedes PB—86-870136.

This bibliography contains citations concerning the toxicity, carcinogenicity, environmental pollution, and other hazards and adverse effects of nickel. The detection, characterization, analytical methods, standards, and removal from the environment are discussed. These aspects of nickel are dealt with in relation to aquatic and terrestrial flora and fauna, including humans. (This updated bibliography contains 278 citations, 30 of which are new entries to the previous edition.)

28271 Presence of free-living amoebae in portable and stationary eye wash stations. Tyndall, R.L.; Lyle, M.M.; Ironside, K.S. (Univ. of Tennessee, Knoxville (USA)). *American Industrial Hygiene Association Journal;* **48**: No. 11, 933-934(Nov 1987). Contract AC05-84OR21400.

Portable and stationary eye wash stations were tested for the presence of free-living amoebae. Such amoebae may be found in potable waters, and at least one genera, the Acanthamoebae, can cause severe infections when introduced into traumatized eyes. Concentrates or filtrates of water from eye wash stations were placed on nonnutrient agar plates seeded with Escherichia coli. Resultant outgrowths of free-living amoebae, which were morphologically identified as mixtures of Hartmannella and Acanthamoebae, were inoculated intranasally into weanling mice. Subsequently, brain and lung tissues from inject mice were tested for amoebae as an indication of persistent infection. Acanthamoebae and Hartmannella were detected in some eye wash stations at each of four test sites. Both portable and stationary stations harbored Acanthamoebae. Some of the isolates caused persistent pulmonary infection but were not isolated from brain tissue. Flushing stationary eye wash stations temporarily reduced the number of stations positive for amoebae. Treatment of portable stations with 25 ppm of free chlorine also reduced the number of stations harboring amoebae but caused corrosion in some of the stations.

5510 Physiological Systems

28272 Average discharge rate representation of voice onset time in the chinchilla auditory nerve. Sinex, D.G.; McDonald, L.P. (Los Alamos National Laboratory, Physiology Group, LS-1, Mail Stop M882, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Acoustical Society of America;* **83**: No. 5, 1817-1827(May 1988).

Responses of chinchilla auditory-nerve fibers to synthesized stop consonants differing in voice onset time (VOT) were obtained. The syllables, heard as /ga/—/ka/ or /da/—/ta/, were similar to those previously used by others in psychophysical experiments with human and with chinchilla subjects. Average discharge rates of neurons tuned to the frequency region near the first formant generally increased at the onset of voicing, for VOTs longer than 20 ms. These rate increases were closely related to spectral amplitude changes associated with the onset of voicing and with the activation of the first formant; as a result, they provided accurate information about VOT. Neurons tuned to frequency regions near the second and third formants did not encode VOT in their average discharge rates. Modulations in the average rates of these neurons reflected spectral variations that were independent of VOT. The results are compared to other measurements of the peripheral encoding of speech sounds and to psychophysical observations suggesting that syllables with large variations in VOT are heard as belonging to one of only two phonemic categories.

5520 Public Health

REFER ALSO TO CITATION(S) 27774, 28143, 28144, 28145, 28146, 28147, 28148, 28149, 28150, 28151, 28152, 28153, 28154, 28155, 28156, 28157, 28158, 28159, 28160, 28168, 28212, 28267, 28299, 28799

28273 (AD-A—188132/5/XAB) Polychlorinated biphenyl (PCB) sampling, Cavalier AFS, North Dakota. Final report. Atkins, I. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Aug 1987. 32p. (USAFOEHL—87-109EH0251HGA). NTIS, PC A03/MF A01.

HQ AF SPACECOM/SGB requested USAFOEHL to determine if maintenance personnel, who conduct periodic maintenance inside transmitter cabinets located in room 301, Phased Array radar Building, Cavalier AFS ND were exposed to hazardous levels of polychlorinated biphenyls (PCBs) and its combustion products. This report explains how USAFOEHL determined ambient and surface levels of polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and PCBs. Additionally, two PCB oil samples were analyzed to determine the level of PCDD and PCDF formation. The PCDDs and PCDFs of interest included 2,3,7,8-tetrachlordibenzodioxin (TCDD) and 2,3,7,8-tetrachlorodibenzofuran (TCDF) as well as the tetra-through-octa chlorinated congener classes of dioxins and furans.

28274 (PB—88-157441/XAB) Chemical Information Manual (OSHA Instruction CPL 2-2.43). (Occupational Safety and Health Administration, Salt Lake City, UT (USA). Analytical Lab.). 20 Oct 1987. 511p. (OSHA/RP—88/001). NTIS, PC A22/MF A01.

This manual presents, in concise form, data on over 800 chemical substances which may be encountered in monitoring workplace environments. The data include sampling and analytical methods currently in use by industrial hygienists and OSHA com-

pliance monitoring activity. Also included are chemical synonyms RTECS and trade names; CAS, NIOSH, and DOT Nos.; OSHA and ACGIH TLV exposure limits; carcinogens status; and health effects. Additionally, methods for general monitoring are listed, including detector tubes and direct-reading instruments. A complete index to chemical substances in the manual is included by synonym and by CAS Nos.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 28018

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 27562, 28240, 28248

28275 **(INIS-BR—1029) Root uptake of exogenous Ra/sup 226/ by three edible vegetables grown in farm soils from the vicinity of the first Brasilian Uranium Mine and Mill.** Teixeira, V.S.; Franca, E.P. (Rio de Janeiro Univ. (Brazil). Inst. de Biofisica). [1988]. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702293/JAW.

The purpose of this work was to evaluate the uptake of exogenous /sup 226/Ra by carrot, brow-bean and cabbage. Greenhouse experiments were carried out with farm soils collected near the first Brazilian Uranium Mine and Mill and contamin ted with /sup 226/Ra solution. After the maturity, the plants were harvested, ashed and this nuclide was analysed by gamma spectrometry. Among the edible parts, /sup 226/Ra content decreased in the following order: cabbage > brown-bean > carrot. Soil-to-plant transfer coeficients were of the order of 10/sup -2/, values of 10 to 100 times greater than those observed in the region. The results emphasize the importance of irrigation water as a contamination pathway of human groups in the area.

28276 **(INIS-mf—11207) Response of human epidermal keratinocytes to UV light.** Kartasova, A.A. (Rijksuniversiteit Leiden (Netherlands)). 21 May 1987. 158p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702384/JAW.

Contains summary in Dutch.

This thesis presents a study on the response of human epidermal keratinocytes to UV light as well as to other agents like 4-NQO and TPA. The effects of ultraviolet (UV) light on the protein synthesis in cultured keratinocytes are presented in ch. III. The next chapter describes the construction of a cDNA library using mRNA isolated from UV irradiated kernatinocytes. This library was differentially screened with cDNA probes synthesized on mRNA from either UV irradiated or nonirradiated cells. Several groups of cDNA clones corresponding to transcripts whose level in the cytoplasm seem to be affected by exposure to UV light have been isolated and characterized by cross-hybridization, sequencing and Northern blot analysis. More detailed analysis of some of the cDNA clones is presented in the two chapters following ch. IV. The complete cDNA sequence of the proteinase inhibitor cystatin A and the modulation of its expression by UV light and the carcinogen 4-nitroquinoline 1-oxide (4-NQO) in keratinocytes are described in ch. V. Two other groups of cDNA clones have been isolated which do not cross-hybridize with each other on Southern blots. However, the primary structures of the proteins deduced from the nucleotide sequences of these two groups of cDNA clones are very similar. 212 refs.; 33 figs.; 2 tabs.

28277 **(INIS-mf—11666) Molecular mechanisms of the direct radiation effects on the DNA: ESR spectroscopy for examining oriented fibres after X-ray exposure.** Voit, K. (Regensburg Univ. (Germany, F.R.). Naturwissenschaftliche Fakultaet 3 - Biologie und Vorklinische Medizin). 1986. 228p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753256/JAW.

This thesis contains experiments, investigating molecular interactions between X radiation and DNA. ESR-spectra of the primary radicals are simulated. The types of secondary radicals are described.

28278 **(INIS-mf—11677) Occurrence and properties of antibodies against virus-associated transformation proteins in radiation-induced osteosarcomas in mice.** Hofherr, J. (Muenchen Univ. (Germany, F.R.). Fachbereich Tiermedizin). 29 Jul 1983. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753260/JAW.

In this thesis it was looked if there is an immunresponse against such viral oncogene products in mice with radiation-induced osteosarcomas. Sera from mice with transplantable radiation-induced osteosacomas showed strong cytotoxicity against cells from a Moloney sarcoma virus-induced tumor and to a smaller extent also against FBJ osteosarcoma virus-transformed nonproducer cells. The cytotoxic activity was bound to the IgM fraction of the sera. Immunprecipitation of /sup 35/S-methionine labelled virus- or radiation-transformed cells with cytotoxic sera showed on PAGE two proteins of molecular weights (m.w.) of about 50-55 kD. A protein of about 38 kD was expressed only in transformed cells whereas another protein of about 43 kD was seen in all cells except in uninfected muscle cells of adult mice. In order to further characterize the nature of these antigens immunprecipitates with unlabelled cells were tested in a protein kinase assay with gamma /sup 32/P ATP and analysed on PAGE. Phosphorylation of proteins occured predominantly of more than 70 kD m.w., of about 68 kD, 50-55 kD and to a lesser extent also of about 32, 34 and 39 kD. The phosphorylation site of the proteins was at serine and threonine residues. These results indicate that mice with radiation-induced osteosarkomas develop antibodies against 'in vivo' and 'in vitro'-sarcoma virus transformed cells.

28279 **(PB—88-170121/XAB) Age-dependent lung dosimetry of radon progeny.** Hofmann, W.; Martonen, T.B.; Menache, M.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Feb 1988. 48p. (EPA—600/D-88/027). NTIS, PC A03/MF A01.

Two morphometric models differing in the tracheobronchial region, were compared in the present paper: Model 1 is based on the adult morphology of Weibel, assuming that all bronchial airways grow in equal proportion; while Model 2 adopts the adult structure proposed by Yeh and Schum, using measured airway dimensions in the right upper lobe as a function of age. Tidal volume and respiratory frequency also vary with age: while the breathing frequency decreases with rising age, tidal volume increases. Radiation doses in each bronchial airway generation were computed for the deep lying basal cells as well as for the more uniformly distributed serous (SMGS) cells, which are currently assumed to be the progenitor cells for bronchial carcinomas. Radiation doses to both target cells were significantly higher in the newborn than in the adult, for all simulated breathing patterns, showing the highest relative increase in upper bronchial airways. Comparing both tracheobronchial growth models, Model 1 predicts higher doses at early ages, but produced lower doses in the adult lung.

28280 **NMR imaging and spectroscopy of the mammalian central nervous system after heavy ion radiation.** Richards, T.; Budinger, T.F. (Lawrence Berkeley Lab., CA (USA)). *Radiation Research;* **113**: No. 1, 79-101(Jan 1988).

NMR imaging, NMR spectroscopy, and histopathologic techniques were used to study the proton relaxation time and related biochemical changes in the rodent brain after in vivo helium beam irradiation with single doses of 10, 20, 30, and 50 Gy. Two-dimensional Fourier transform spin-echo imaging and saturation recovery with projection reconstruction were used to measure the NMR relaxation parameters. These parameters were correlated with proton spectroscopy and histopathology. Additional high resolution in vitro proton spectroscopy was performed on brain extracts to observe chemical changes that could not be seen in vivo. The major findings from these experiments were that at 4-14 days postirradiation, image intensity and T1 relaxation time decreased on the irradiated side and increased on the nonirradiated side relative

to nonirradiated control animals. In vivo surface coil proton spectroscopy methods demonstrated changes in lipid and phosphatidylcholine (p-choline) peaks. In vitro studies of the aqueous fraction of brain extracts showed radiation-induced changes in lactate, 4-aminobutyric acid, and p-choline peak areas. In the organic fraction, radiation-induced changes were observed in phosphatidylcholine, phosphatidylethanolamine, and phosphatidylserine. With histology and Evans blue injections, blood-brain barrier alterations were seen as early as 4 days after a dose of 50 Gy.

28281 **Mutations in Escherichia coli that effect sensitivity to oxygen.** Jamison, C.S.; Adler, H.I. (Oak Ridge National Lab., TN). *Journal of Bacteriology;* 169: No. 11, 5087-5094(Nov 1987). Contract AC05-84OR21400.

Fifteen oxygen-sensitive (Oxy/sup s/) mutants of Escherichia coli were isolated after exposure to UV light. The mutants did not form macroscopic colonies when plated aerobically. They did form macroscopic colonies anaerobically. Oxygen, introduced during log phase, inhibited the growth of liquid cultures. The degree of inhibition was used to separate the mutants into three classes. Class I mutants did not grow after exposure to oxygen. Class II mutants were able to grow, but at a reduced rate and to a reduced final titer, when compared with the wild-type parent. Class III mutants formed filaments in response to oxygen. Genetic experiments indicated that the mutations map to six different chromosomal regions. The results of enzymatic assays indicated that 7 of the 10 class I mutants have low levels of catalase, peroxidase, superoxide dismutase, and respiratory enzymes when compared with the wild-type parent. Mutations in five of the seven class I mutants which have the low enzyme activities mapped within the region 8 to 13.5 min. P1 transduction data indicated that mutations in three of these five mutants, Oxy/sup s/-6, Oxy/sup s/-14, and Oxy/sup s/-17, mapped to 8.4 min. The correlation of low enzyme levels and mapping data suggest that a single gene may regulate several enzymes in response to oxygen. The remaining three class I mutants had wild-type levels of catalase, peroxidase, and superoxide dismutase, but decreased respiratory activity. The class II and III mutants had enzyme activities similar to those of the wild-type parent.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 27563, 28112, 28129, 28130, 28132, 28161, 28179, 28241, 28248, 28267, 28268

28282 **(AD-A—188335/4/XAB) Air quality and human performance. Chapter 16.** Pandolf, K.B. (Army Research Inst. of Environmental Medicine, Natick, MA (USA)). Sep 1987. 62p. (USARIEM-M—67-87). NTIS, PC A04/MF A01.

The various air pollutants have been classified as primary or secondary pollutants. Primary pollutants are emitted directly to the environment from their source and include carbon monoxide, sulfur oxides, nitrogen oxides, and primary particulates. Secondary pollutants develop from interactions of primary pollutants and include ozone, peroxyacetyl nitrate, and certain aerosols. Carbon monoxide does not appear to cause decrements in submaximal exercise performance in healthy individuals; however, cardiovascularly-impaired individuals appear to be at significant risk during submaximal exercise even at low carboxyhemoglobin levels. Maximal exercise performance for healthy individuals seems to be altered by breathing carbon monoxide with the critical concentration being 4.3% carboxyhemoglobin. The threshold level of sulfur dioxide which effects submaximal exercise performance in healthy individuals is between 1.0 and 3.0 ppm while asthmatic individuals and possibly others with pulmonary hyperactivity are affected at a lower threshold concentration between 0.20 and 0.50 ppm. Several studies suggest that healthy and asthmatic individuals may adapt to sulfur but, unfortunately, no research has investigated adaptation to this pollutant during physical exercise. While no studies have been reported which evaluate maximal exercise performance, nitrogen dioxide exposure does not appear to adversely affect submaximal exercise performance in healthy individuals. The physiological performance effects of breathing primary particulates have not been directly evaluated during exercise in man. Ozone exposure does not appear to limit submaximal exercise performance at light to moderate exercise intensities.

28283 **(PB—88-161344/XAB) Dynamics of polychlorinated biphenyls in striped bass from the hudson river. 3. Tissue disposition and routes for elimination.** O'Connor, J.M.; Pizza, J.C. (New York Univ., NY (USA). Inst. of Environmental Medicine). 1987. 12p. NTIS, PC A03/MF A01.

Pub. in Estuaries, Vol. 10, No. 1, 68-77(Mar 1987).

Striped bass were exposed to ^{14}C-polychlorinated biphenyls (PCB) in single-dose and multiple-dose experiments. Samples were analyzed to determine rate constants for PCB elimination from individual tissues, PCB concentration in tissues, the proportion of the PCB burden retained and the proportion of the cumulative dose retained by each tissue at various times after exposure. An experiment was also conducted to determine both the potential for secondary PCB uptake in dietary exposure studies and the relative tissue disposition of PCBs assimilated from dietary sources as compared to direct water uptake. PCBs were present in the tissues of striped bass within 6 h after administration of a single dose. Certain tissue compartments, such as the liver/gall bladder, accumulated PCBs over a period of 48 h even though the whole-body burden had decreased between 24 and 48 h. The most-likely route for PCB elimination from striped bass was from tissues to the liver and thence to the intestine via the bile. There were no differences in the tissue disposition of PCB related to route of exposure.

28284 **(PB—88-161807/XAB) Feasibility of dose adjustment based on difference in long-term clearance rates of inhaled particulate matter in humans and laboratory animals.** Pepelko, W.E. (Environmental Protection Agency, Washington, DC (USA). Carcinogen Assessment Group). 1987. 19p. (EPA—600/J-87/225). NTIS, PC A03/MF A01.

Pub. in Regulatory Toxicology and Pharmacology, Vol. 7, 236-252(1987).

Long-term pulmonary clearance rates were evaluated for several laboratory animal species, dogs, and humans to determine if differences among species exist, and if so, the adequacy of the data for dose adjustment. Within each species, large variations in clearance rates were seen, probably as a result of differences in solubility of the aerosol particles, differences in measurement techniques, possible lung damage, transport to lung-associated lymph nodes, and binding of dissolved chemicals to cellular macromolecules in the lung. While few direct comparisons among species using the same aerosol were available, mechanical clearance of particles from the alveolar regions of dogs and humans was generally slower than in most laboratory species, with t1/2 values several-fold longer. Particle clearance rate-variations of the magnitude were shown to induce potentially large differences in bioavailability. This can result in large errors in assessing human risk from animal studies unless a dose adjustment is made.

28285 **(PB—88-169859/XAB) Toxicology and carcinogenesis studies of ethylene oxide (CAS No. 75-21-8) in B6C3F1 mice (inhalation studies). Technical report series (Final).** (National Toxicology Program, Research Triangle Park, NC (USA)). Nov 1987. 113p. (NTP-TR—326). NTIS, PC A06/MF A01.

Two-year toxicology and carcinogenesis studies of ethylene oxide were conducted by exposing groups of 50 B6C3F(1) mice of each sex to air containing 0, 50, or 100 ppm ethylene oxide 6 hours per day, 5 days per week for 102 weeks. Under the conditions of these 2-year inhalation studies, there was clear evidence of carcinogenic activity for B6C3F(1) mice as indicated by dose-related increased incidences of benign or malignant neoplasms of the lung and benign neoplasms of the harderian gland in both male and female B6C3F(1) mice following exposure to ethylene oxide vapors at 50 and 100 ppm. In female mice, ethylene oxide caused additional malignant neoplasms of the uterus, mammary gland, and hematopoietic system (lymphoma).

28286 **(PB—88-170048/XAB) Cellular and biochemical changes in the lower airways of subjects exposed to ozone.** Koren, H.S.; Devlin, R.B.; Graham, D.E.; Mann, R.; Horstman, D.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Feb 1988. 29p. (EPA—600/D-88/031). NTIS, PC A03/MF A01.

Although exposure of animals to ozone (O_3) has been shown to impair host defense mechanisms and to induce inflammation, very little is known about its inflammatory effects in humans. In the study, 11 healthy males, age 18-35, were exposed to 0.4 ppm O_3 or filtered air for two hours with intermittent exercise. Eighteen hours later, bronchoalveolar lavage (BAL) was performed. There was an 8.2-fold increase in the number of polymorphonuclear leukocytes (PMNs), and a corresponding decrease in the number of macrophages, indicative of an inflammatory response. No significant change in the number of lymphocytes was observed. A two-fold increase in the levels of classical indicators of vascular permeability (protein and albumin) clearly indicated that an acute O_3 exposure can increase permeability. A selected number of biochemical markers known to be associated with inflammation were examined. The results of the study show that an acute exposure to O_3 can result in increased levels of inflammatory materials capable of producing pathophysiological changes in the lower airways of humans.

28287 (PB—88-170170/XAB) Cotton-yield responses to ozone as mediated by soil moisture and evapotranspiration. Temple, P.J.; Taylor, O.C.; Benoit, L.F. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). 1985. 8p. NTIS, PC A02/MF A01.

Pub. in Jnl. Environmental Quality, Vol. 14, No. 1, 55-60(1985).

Cotton (Gossypium hirsutum L. cv. 'SJ-2'), grown in open-top chambers in the Central Valley of California, was exposed to 6 ozone (O_3) treatments ranging from charcoal-filtered (CF) to ambient plus 0.10 ppm O_3 (1981) or twice ambient O_3 concentrations (1982) for the entire growing seasons of 1981 and 1982. Half the plots were irrigated optimally and the other half were water-stressed by providing 25% (1981) or 20% (1982) less irrigation water. During the typically hot, dry growing season of 1981, cotton yield in normally irrigated (NI) treatments was reduced 20% in non-filtered (NF) chambers relative to CF controls. Doubling ambient O_3 concentration reduced yield 45%. Water-stressed (WS) plants showed almost no response to O_3. In 1982, potential evapotranspiration during the growing season averaged 20% less and ambient O_3 concentration averaged 39% lower than in 1981. Under these growing conditions, cotton yields in NI and WS treatments responded similarly to O_3. Yields in NF chambers were reduced 15% relative to CF chambers. Doubling ambient O_3 concentrations reduced yields 65%. The greater relative response of cotton to O_3 in 1982 may have resulted from the cooler more humid growing conditions, which increased the susceptibility of cotton to O_3.

28288 (PB—88-170717/XAB) Model of the regional uptake of gaseous pollutants in the lung. 2. The sensitivity of ozone uptake in laboratory animal lungs to anatomical and ventilatory parameters. Overton, J.H.; Graham, R.C.; Miller, F.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 17p. (EPA—600/J-87/200). NTIS, PC A03/MF A01.

Pub. in Toxicology and Applied Pharmacology 88, 418-432(May 1987); See also PB—85-243970.

An O_3 dosimetry model is used to simulate the local absorption of O_3 in the lower respiratory tract (LRT) of rats and guinea pigs. The model takes into account LRT anatomy, transport in the lumen and air spaces, transport and chemical reactions in the mucous and surfactant layers and in the underlying tissue and capillaries. For each species two anatomical models were used to investigate their influence in predicting absorption. Results with all four anatomical models and various ventilatory parameters showed a qualitative similarity in the shape of the dose versus airway number curves but significant differences in predicted percent total and percent pulmonary uptake. The percent uptake was also sensitive to breathing frequency and tidal volume. Rat lobe models were used to study absorption in lobes and show that O_3 tissue dose in centriacinar regions decrease with increasing distance from the trachea. The effect on results of values used for functional residual capacity (FRC) and of values used for the chemical rate constants for O_3 reactions in mucus were explored. Results differed quantitatively but not qualitatively.

28289 (PB—88-170790/XAB) Issues that must be addressed when constructing anatomical models of the developing lung. Menache, M.G.; Graham, R.C. (Northrop Services, Inc., Research Triangle Park, NC (USA)). Feb 1988. 32p. NTIS, PC A03/MF A01.

Published data on airway dimensions in the developing human lung, including estimated age-dependent changes and experimental data, are summarized to illustrate the variability and gaps in the data used to develop anatomical models for deposition calculations. A comparison of the morphological dimensions resulting from various assumptions about the volume distribution of pulmonary airways is also presented. Although deposition is not examined here, the varibility in reported measurements underscores the influence that anatomical parameters can have on deposition calculations and the importance of further investigation of lung dimensions to reduce the uncertainties in computer simulations of delivered dose, thereby improving the data base necessary for risk assessment.

28290 Development of analytic models for placental transfer of the heaviest metals. Sikov, M.R.; Kelman, B.J. (Pacific Northwestern Lab., Richland, WA (USA)). *Proceedings of the Society for Experimental Biology and Medicine;* **186**: No. 3, 392(Dec 1987). Contract AC06-76RL01830.

Inferential information concerning placental passage has been obtained from sequential measurements of concentration ratios in the embryo/fetus and in pregnant animals following injection, and experiments in perfused placentas have provided kinetic data. Although wide ranges of values are reported, results generally indicate that most heavy metals do not readily cross the placental barriers or deposit in the conceptus after acute exposures. Concentration measurements in human and in wild and domestic animal populations, which provide data relating to environmental exposures, suggest that relative fetal deposition is greater with chronic than with acute exposures. There are several factors that influence placental transfer and fetoplacental content. These include mass and physicochemical state, route of administration, species-specific changes in placental structure and function relative to stage of gestation at exposure, and stage-related changes in tissue affinities. We will compare the fetoplacental metabolism of the heaviest metallic elements ($Z \geq 82$) to illustrate these several concepts, and to examine and compare the models that have been proposed to describe and explain these patterns and to provide a basis for extrapolation to man.

28291 Particle concentration in exhaled breath. Fairchild, C.I.; Stampfer, J.F. (Los Alamos National Lab., NM (USA)). *American Industrial Hygiene Association Journal;* **48**: No. 11, 948-949(Nov 1987).

Measurements were made of the number of concentration of particles in exhaled breath under various conditions of exercise. A laser light scattering particle spectrometer was used to count particles exhaled by test subjects wearing respirators in a challenge environment of clean, dry air. Precautions were taken to ensure that particles were not generated by the respirators and that no extraneous water or other particles were produced in the humid exhaled air. The number of particles detected in exhales air varied over a range from <0.10 to ~ 4 particles/cm^3 depending upon the test subject and his activity. Subjects at rest exhaled the lowest concentration of particles, whereas exercises producing a faster respiration rate caused increased exhalation of particles. Exhaled particle concentration can limit the usefulness of nondiscriminating, ambient challenge aerosols for the fit testing of highly protective respirators.

28292 Species differences in the distribution of inhaled butadiene in tissues. Bond, J.A.; Dahl, A.R.; Henderson, R.F.; Birnbaum, L.S. (Lovelace Biomedical and Environmental Institute, Albuquerque, NM (USA)). *American Industrial Hygiene Association Journal;* **48**: No. 10, 867-872(Oct 1987). Contract AC04-76EV01013.

1,3-butadiene is produced commercially for use in the manufacture of elastomers, polymers and other chemicals. Recent inhalation carcinogenicity studies of butadiene indicate that B6C3F$_1$ mice are more sensitive to the tumorigenic effects of inhaled butadiene than are Sprague Dawley rats. The purpose of this investigation

was to determine if there were differences in distribution in tissues of inhaled butadiene between rats and mice. Male Sprague Dawley rats and B6C3F$_1$ mice were exposed nose-only for 3.4 hr to (mean +/- SE) 1220 +/- 71 μg ^{14}C-butadiene/L air and 121 +/- 2 μg ^{14}C-butadiene/L air, respectively. Radioactivity was distributed widely in tissues immediately following exposure of both rats and mice to ^{14}C-butadiene. In both species, respiratory tract tissue (lung, trachea, nasal turbinates), gastrointestinal tract (small and large intestine), liver, kidneys, urinary bladder and pancreas contained high concentrations of radioactivity within 1 hr after the end of a exposure. In all cases, tissues of mice contained 15 to 100 times the concentration of ^{14}C-butadience equivalents per μm mole of butadiene inhaled than did rats. For both rats and mice, elimination of ^{14}C from tissues and blood was rapid, with 77% to 99% of the initial tissue burden being eliminated with half-times of 2 to 10 hr. Within 1 hr after the end of exposure, all rat tissues retained a substantial amount of ^{14}C that was associated with volatile material that was probably butadiene and/or metabolites. A similar observation was noted in mouse liver, the only tissue of mice examined. The data indicate that there were no apparent differences between rats and mice in tissue depots for ^{14}C derived from butadiene, but that, per μmole of butadiene inhaled, tissues of mice attained significantly greater concentrations of ^{14}C than did rats.

28293 **Roles of stimulus control and reinforcement frequency in modulating the behavioral effects of d-amphetamine in the rat.** Rees, D.C.; Wood, R.W.; Laties, V.G. (Univ. of Rochester, NY). *Journal of Experimental Analysis of Behavior;* **43**: No. 2, 243-255(Mar 1984).

The behavioral effects of d-amphetamine have been shown to be modulated by stimulus control, with less impairment of performance occurring when control is great. When the fixed-consecutive-number schedule is used (on which at least a specified consecutive number of responses must be made on one operandum before a single response on another will produce a reinforcer), response rate tends to invariant but reinforcement frequency is not. This study asks whether the differences in reinforcement frequency that usually accompany changes in stimulus control could themselves be responsible for the performance differences. Two versions of the fixed-consecutive-number schedule of reinforcement were combined into a multiple schedule within which stimulus control was varied but differences in reinforcement frequency were minimized by omitting some reinforcer deliveries during the component that usually had the higher reinforcement frequency. In one component, a compound discriminative stimulus was added with the eighth consecutive response on the first lever, a single response on the second lever was then reinforced. In the other component, no such stimulus was presented. With no added stimulus, large decreases occurred in the number of runs satisfying the minimum requirement for reinforcement at doses of drug that produced only minimal changes when an added stimulus controlled behavior. Thus, increased stimulus control diminishes the behavioral changes produced by d-amphetamine even when the possible contribution by baseline reinforcement rate is minimized. 17 references, 6 figures, 4 tables.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 27943

28294 **(AD-A—187703/4/XAB) Laser flash effects on chromatic discrimination in monkeys. Final report, April 1986-June 1987.** Schmeisser, E.T. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Oct 1987. 26p. (USAFSAM-TR—87-17). NTIS, PC A03/MF A01.

Detecting a camouflaged target in a visually noisy background depends on the ability of the observer to discriminate the target from the surrounding terrain. Visible laser irradiation at less than damage levels can act as a masking source by compromising or reducing the observer's ability to resolve differences in the visual scene. Previous research has examined this concept by investigating laser flash effects on: acuity (size discrimination); tracking (motion discrimination); visual sensitivity (color); and contrast sensitivity functions (luminance contrast). In all cases, flashes from continuous-wave (CW) sources have proven more effective visually than pulsed (Q-switched) sources, when compared on peak-energy criteria (i.e., MPE), even though Q-switched lasers induce damage at lower energy doses. Additionally, the inherent safety of ultra-short laser pulses has been questioned. Past animal research has shown that, on the measures of acuity, sensitivity, tracking, and contrast detection, the animals recover to baseline if the exposure has remained below the MPE. The one measure that has not been investigated is color discrimination. The major conclusions from this investigation are: (a) red and green colored laser flashes shift the color balance transiently in the visual system, and yellow flashes do so to a lesser extent; thus targets may change both hue and brightness after an observer receives colored flashes; and (b) Q-switched lasers, at non-lesioning levels, when equated for time-averaged perceptual brightness, have comparable effects to flashes with longer time courses.

28295 **(AD-A—188156/4/XAB) Critical phenomena and electromagnetic effects in biological membranes. Annual report, November 1986-October 1987.** Bond, J.D.; Wyeth, N.C.; Jordan, C.A. (Science Applications International Corp., McLean, VA (USA)). 30 Oct 1987. 12p. (SAIC—87/1167). NTIS, PC A03/MF A01.

A physical basis is established whereby external electromagnetic fields can interact with biological membranes. The mechanism discussed, based on the membrane residing in a thermodynamic state near critical point, can accommodate very low field strengths. Numerical estimates of field strengths required to drive the membrane system close enough to a critical point, assuming it does not initially reside there, are presented.

28296 **(AD-A—188255/4/XAB) Long-term bioeffects of 435-MHz radiofrequency radiation on selected blood-borne endpoints in cannulated rats. Volume 4. Plasma catecholamines. Final report, October 1982-June 1985.** Popovic, V.P.; Toler, J.C.; Bonasera, S.J.; Popovic, P.P.; Honeycutt, C.B. (Georgia Inst. of Tech., Atlanta (USA). Research Inst.). Aug 1987. 119p. NTIS, PC A06/MF A01.

See also Volume 1, AD-A175 347.

Two hundred adult male white rates (Sprague-Dawley) with chronically implanted aortic cannulas were randomly divided into two groups. Animals in the first group were exposed to low-level (1.0mW/sq cm) pulsed-wave 435-MHz radiofrequency radiation (RFR) for about 22 h daily, 7 days each week for 6 months. Animals in the second group were maintained under identical conditions but were not irradiated. The aortic cannulas were used to draw microsamples (0.6 mL) of aortic blood from the unrestrained, unanesthetized rats on a cyclic schedule. Plasma catecholamine (nonrepinephrine, epinephrine, and dopamine) concentrations were determined by radioimmunoassays. Statistical analysis of the results did not indicate increased plasma catecholamine concentrations on radiation-exposed animals when compared to sham-exposed animals. Exposure to this nonionizing radiofrequency (RF) environment did not induce stresses that were manifested as an alteration in plasma hormones.

28297 **(AD-A—188579/7/XAB) Cellular response to exogenous electromagnetic fields. Annual report, October 1986-September 1987.** Goodman, R.; Henderson, A.S. (Columbia Univ., New York (USA). Dept. of Pathology). 21 Sep 1987. 5p. NTIS, PC A02/MF A01.

This research has determined that extremely-low-frequency (ELF) (100-Hz) electromagnetic (EM) fields induce alterations in transcription and translation in dipteran (Drosophila, Sciara) and human (HL60, IB4) cells. Transcriptional autoradiography and endoreplicated chromosomes, as well as analyses of sucrose density-gradient profiles, shows increased uptake of ^{3}H uridine into RNA following exposure of cells to sinusoidal and asymmetric quasi-rectangular signals for time periods up to 60 minutes. Biochemical analyses (sucrose density gradients, oligo (d) T columns) have demonstrated that the RNA affected by signal stimulation is in the messenger-RNA size class. Quantitative and qualitative alterations also occur in polypeptide synthesis following EM-field stimulation. Major differences are noted from control among all sets analyzed with respect to new and augmented, as well as suppressed and deleted polypeptides. Using hybridization analysis, there is preliminary evidence that cell-specific transcripts are augmented.

28298 (AD-A—188887/4/XAB) Photonic temperature and pressure sensors for biosystems/pulsed microwave. 1. Interaction studies. Final report, 1 October 1984-30 September 1986. Kersey, A.D.; Dandridge, A. (Naval Research Lab., Washington, DC (USA)). Sep 1987. 68p. NTIS, PC A04/MF A01.

This report details research efforts at the Naval Research Laboratory into the development of miniature, high-frequency, optical-fiber pressure and temperature sensors for use in monitoring transient pressure and heating in biological samples under microwave irradiation. The first sections of the report describe the various pressure and temperature sensor configurations studied and/or tested experimentally. Section B reports the results obtained with field-tested (at Walter Reed) prototype sensors, and Section C describes the operational details and calibration of the temperature and pressure sensor units for delivery to Walter Reed.

28299 (PB—88-162730/XAB) Health-hazard evaluation report HETA 87-169-1830, Mountain Bell, Idaho Falls, Idaho. Gunter, B.J.; Boiano, J.M.; Sinks, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1987. 14p. (HETA—87-169-1830). NTIS, PC A03/MF A01.

In response to a request from the Communication Workers of America, an evaluation was made of possible leakage of radiofrequency/microwave (RF/MW) radiation from long-distance telephone relay equipment at Mountain Bell, in Idaho Falls, Idaho. Measurements were taken of RF/MW radiation around transmitters, associated waveguide runs, transmitting and receiving dishes, and at the relay station. Measurements were also made at the central transmitting station in Idaho Falls where nine transmitter/receivers and one paging system were evaluated. All produced less than the detection limits of 10 microwatts per square centimeter for power density and 500 volts squared per square meter for electric-field measurements. As part of the medical evaluation, eight current employees and one former employee were interviewed. None reported any medical conditions which the authors believed were work-related. All current workers denied specific symptoms. The retired worker did report neurologic symptoms, however, medical evaluation of his symptoms did not identify a cause for his condition. The authors conclude that there is currently no danger from microwave radiation at these sites, and since there has been almost no modernization of the equipment in some years, there is little chance that such exposures have occurred.

28300 (PB—88-167580/XAB) Noise from electrical machinery. Tukker, I.J.C. (Nijverheidsorganisatie TNO, Delft (Netherlands). Technisch Physische Dienst). Aug 1987. 171p. (In Dutch). NTIS, PC E07/MF A01.

This report contains the results of a study of the literature on noise emissions from rotating electric machines and energy transformers. Noise-abatement possibilities are also inventored. National and international noise emission limits are given for both types of machine. These limits apply to machines of standard design without special noise-abatement measures. The limits, according to those who set them, are intended to enable users to determine whether the machines that they plan to purchase conform to the latest technological standards. However, in respect of rotating machines the report deals in more detail with the question of how these limits relate to the current state of the technology involved. Besides machines of standard design, almost all manufacturers offer machines or energy transformers of a low-noise design.

28301 (PB—88-859723/XAB) Nonionizing electromagnetic radiation: biological effects. January 1972-March 1988 (Citations from the International Aerospace Abstracts data base). Report for January 1972-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 119p. NTIS PC N01/MF N01.

Supersedes PB—86-873080; U.S. sales only.

This bibliography contains citations concerning the biological effects of non-ionizing electromagnetic radiation. Energy absorption and radiation effects to humans, animals, and insects are discussed. Theoretical and experimental dosimetry are considered. Safety standards are included. (This updated bibliography contains 251 citations, 15 of which are new entries to the previous edition.)

28302 (PB—88-861067/XAB) Architectural acoustics. January 1975-March 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 111p. NTIS PC N01/MF N01.

Supersedes PB—86-861432.

This bibliography contains citations concerning architectural acoustics and the improvements in acoustical insulating materials for the reduction of acoustical noise in office spaces, private dwellings, and industrial manufacturing plants. Topics include noise control in open-plan offices, impact noise through floors, sound isolation between dwellings, and sound insulation of windows. The testing and evaluation of a variety of acoustical insulating building materials are presented. (This updated bibliography contains 249 citations, 35 of which are new entries to the previous edition.)

28303 Exposure guidelines for magnetic fields. Miller, G. (Lawrence Livermore National Lab., CA (USA)). *American Industrial Hygiene Association Journal;* **48**: No. 12, 957-968(Dec 1987).

The powerful magnetic fields produced by a controlled fusion experiment at Lawrence Livermore National Laboratory (LLNL) necessitated the development of personnel-exposure guidelines for steady magnetic fields. A literature search and conversations with active researchers showed that it is currently possible to develop preliminary exposure guidelines for steady magnetic fields. An overview of the results of past research into the bioeffects of magnetic fields was compiled, along with a discussion of hazards that may be encountered by people with sickle-cell anemia or medical electronic and prosthetic implants. The LLNL steady magnetic-field exposure guidelines along with a review of developments concerning the safety of time-varying fields were also presented in this compilation. Guidelines developed elsewhere for time varying fields were also given. Further research is needed to develop exposure standards for both steady or time-varying fields.

57 HEALTH AND SAFETY

28304 (CEPN—85) From risk analysis to risk control in land transport of dangerous materials. Contribution of quantitative evaluation. Hubert, P.; Pages, P. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)). Mar 1985. 92p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753181/JAW.

The different approaches of risks and risk management system are described: statistics, potential risk, prevention, information and intervention. Quantitative evaluation is developed: data collection, purposes and methods. Two examples of application are given on risks associated to road transport of propane and of uranium hexafluoride. In conclusion level of risk and practical use of studies on risks are examined. 41 refs.

58 GEOSCIENCES

5802 Geophysics

REFER ALSO TO CITATION(S) 27464, 27772, 28105, 28106

28305 (AD-A—188862/7/XAB) Sky-polarization data for volcanic and non-volcanic periods. Report for April-September 1986. Longtin, D.R.; Volz, F.E. (Optimetrics, Inc., Burlington, MA (USA)). Oct 1986. 71p. (OMI—180). NTIS, PC A04/MF A01.

Volz has monitored the Arago and Babinet neutral points at Lexington and Bedford, Mass. for the years 1968 to 1986. These data, along with measurements of turbidity, twilight color ratio, solar aureole, and cloud and snow cover, have been assembled into a data base and checked for error. The neutral-point data were then corrected for day-to-day variations in tropospheric turbidity and separated into groups that coincide with time periods of known volcanic influences and seasonal events. 3-D plots indicate that both

the Arago and Babinet points were strongly affected by the presence of the El Chichon dust cloud; however, the features were not as pronounced as in the tropics. Measurements made after the El Chichon eruptions also suggest a movement of the neutral points after sunset which was not observed after the eruptions of Mt. Pelee in 1902 and Katmai in 1911. The present measurements did not show an effect from the eruptions of Fuego in 1971 and late 1974.

28306 **(PB—88-159595/XAB) Space-based remote sensing of the Earth: a report to the Congress.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA)). Sep 1987. 148p. NTIS, PC A07.

Also available from Supt. of Docs.

The legislation calling for the commercialization of the Landsat Satellites, Public Law 98-365 requires that the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) jointly prepare and submit to the Congress a biennial series of reports on remote-sensing research and development applied to the Earth and its atmosphere. The report responds to the 1985 and 1987 Congressional reporting requirements and reviews ongoing Federal research programs in the remote sensing of land, oceans, and atmosphere. The report discusses objectives, progress, and accomplishments as of May 1, 1987. It identifies major gaps in the knowledge of the Earth and its atmosphere and derives a series of space-based measurement objectives. The near-term (approximately through 1992) space-observations programs of the United States and other countries are detailed. The report represents the start of the planning process to develop an integrated national program for research and development in Earth remote sensing for the remainder of the century and describes the many existing and proposed satellite and sensor systems that the program may include.

28307 **(PB—88-163704/XAB) Liquefaction potential for New Uork state: a preliminary report on sites in Manhattan and Buffalo. Technical report.** Budhu, M.; Vijayakumar, V.; Giese, R.F.; Baumgras, L. (National Center for Earthquake Engineering Research, Buffalo, NY (USA)). 31 Aug 1987. 46p. (NCEER—87-0009). NTIS, PC A03/MF A01.

The chances of a major earthquake occurring in New York in the near future is low. However, New York has experienced and no doubt will continue to experience moderate earthquakes. Catastrophic damage due to structural causes is not likely to occur for non-masonry buildings, but ground failure due to soil liquefaction is possible. It appears from the study that areas that lie adjacent to bodies of water (the Harlem River in Manhattan and Lake Erie in Buffalo) are liable to liquefy.

28308 **Density logging using an electron linear accelerator as the x-ray source.** King, G. III; Becker, A.J.; Corris, G.W.; Boyce, J.R.; Bramblett, R.L. (Schlumberger-Doll Research, Ridgefield, CT (USA)). pp 990-994 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A research sonde has been developed which uses x-rays generated by an electron linear accelerator to probe geological formations. Research interests for this x-ray source encompass such measurements as formation density, lithology and neutron porosity, even in the presence of casing and with the possibility of logging speeds approaching those of induction tools. We have taken advantage of the higher energy, higher intensity and directionality of the source radiation to reliably measure formation bulk density. These source features make it possible to accommodate longer detector spacings and higher logging speeds without sacrificing measurement precision. Radiation sensors are located at several positions from the x-ray source and sample formation scattered radiation from shallow and deep regions within the formation. The current research sonde is an eccentered, mandrel-type device with a sizable sensitivity to borehole standoff effects. Therefore, the complexities associated with signal processing for this measurement are increased. We have been successful in unfolding the influence of standoff in the density measurement.

5803 Mineralogy, Petrology, And Rock Mechanics

28309 **Aperture correlation of a fractal fracture.** Wang, J.S.Y.; Narasimhan, T.N.; Scholz, C.H. (Earth Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley). *Journal of Geophysical Research;* 93: No. B3, 2216-2224(10 Mar 1988).

A rough-walled facture is modeled by fractal geometry. In the fractal fracture model, the rock surfaces are characterized by a fractal dimension D between 2 and 3, with lower D for smoother surfaces and higher D for rougher surfaces. The mismatch due to shear displacement between two mirror-image fractal surfaces determines the fracture aperture distribution. An analytic equation is derived for the varioram γ/sub f/(r) describing the spatial correlation of the aperture of a fractal fracture. The aperture of a smooth fracture with low D is highly correlated over distances much larger than the shear displacement. The aperture of a rough fracture with high D becomes uncorrelated within a range shorter than the shear displacement. Near the origin, r = 0, of the variogram, the variogram is proportional to r/sup 6-2//sup D/. For the special case of Brownian fractal with D = 2.5, the variogram is proportional to r, which is the same r dependence exhibited by the spherical model widely used in geostatistical analyses. copyright American Geophysical Union 1988

5804 Geochemistry

REFER ALSO TO CITATION(S) 27474

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 28346, 28353, 28502, 28628, 28727, 28758

28310 **(AD-A—187791/9/XAB) Relationship of shock-associated kilometric radio emission with metric type II bursts and energetic particles.** Kahler, S.W.; Cliver, E.W.; Cane, H.V. (Emmanuel Coll., Boston, MA (USA). Physics Research Div.). 1986. 5p. NTIS, PC A02/MF A01.

Pub. in Advances in Space Research, Vol. 6, No. 6, 319-322(1986).

Shock-associated (SA) events are a class of kilometric-wavelength solar radio bursts first observed with the ISEE-3 Radio Astronomy Experiment. These fast-drift events are typically associated with metric type II bursts and hypothesized that the SA events were due to electrons accelerated by coronal shocks. Compare SA events from 1978 to 1982 with metric type II bursts and solar energetic particle (SEP) events. Most metric type II bursts are not obviously associated with SA events at 1980 kHz. Metric type II bursts associated with magnetically well connected flares and SA emission are well correlated with SEP events; those without SA emission are poorly correlated with SEP events. The largest SEP events from flares at any longitude are well correlated with SAs. These results are consistent with the hypothesis that the escaping electrons giving rise to SA emission are accelerated in coronal shocks.

28311 **(AD-A—187792/7/XAB) Characteristics of solar coronal source regions producing ^{3}He-rich particle events.** Kahler, S.W.; Lin, R.P.; Reames, D.V.; Stone, R.G.; Liggett, M. (Emmanuel Coll., Boston, MA (USA)). 1987. 11p. NTIS, PC A03/MF A01.

Pub. in Solar Physics, Vol. 107, 385-394(1987).

H/sub alpha/, x-ray, and kilometric radio data are used to examine the solar coronal activity associated with energetic about 1 MeV/inverse nuclear ^{3}He-rich particle events observed near Earth. The basis of the study is the 12 He3-rich events observed in association with impulsive 2- to 100-keV electron events. When H/sub alpha/ and x-ray brightenings can be associated with ^{3}He electron events, they have onsets coinciding to within 1 min of that of the associated metric type III bursts. In three or four events no associated H/sub alpha/ or x-ray flares, and in two events even the metric type III bursts were weak or absent. The measured low-

energy (2 keV) electron spectra for these events show no evidence of a flattening due to Coulomb collisional losses. These results and several other recent findings are consistent with the idea that the ^{3}He/electron events are due to particle acceleration in the corona well above the associated H/sub alpha/ and x-ray flares.

28312 (AD-A—187807/3/XAB) Solar energetic proton events and coronal mass ejections near solar minimum. Kahler, S.W.; Cliver, E.W.; Cane, H.V.; McGuire, R.E.; Reames, D.V. (Emmanuel Coll., Boston, MA (USA)). 15 Aug 1987. 5p. NTIS, PC A02/MF A01.

Pub. in International Cosmic Ray Conference. Conference Papers, Vol. 3, 121-123(15 Aug 1987).

The association of coronal mass ejections (CMEs) with solar energetic (9-23 MeV) proton (SEP) events are examined during the 1983-1985 approach to solar minimum. Twenty-two of 25 SEP events were associated with CMEs, a result comparable to that previously found for the period 1979-1982 around solar maximum. Peak SEP fluxes were correlated with CME speeds but not with CME angular sizes. In addition, many associated CMEs lay well out of the ecliptic plane. In a reverse study using all west hemisphere CMEs lay CMEs of speeds exceeding 800 km/s and covering the period 1979-1985, 29 of 31 events originating on the solar disk or limb were associated with observed SEPs. However, in contrast to the previous study, no cases of SEP events were found associated with magnetically well connected flares of short duration that lacked CMEs.

28313 (AD-A—188238/0/XAB) Interplanetary shocks preceded by solar-filament eruptions. Cane, H.V.; Kahler, S.W.; Sheeley, N.R. (Emmanuel Coll., Boston, MA (USA)). 1 Dec 1986. 10p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 91, No. A12, 13321-13329(1 Dec 1986).

Solar and interplanetary characteristics of six interplanetary shock and energetic particle events associated with the eruptions of solar filaments lying outside active regions are discussed. The events are characterized by the familiar double-ribbon Hx brightenings observed with large flares, but only very-weak soft x-ray and microwave bursts. Both impulsive phases and metric type-II bursts are absent in all six events. The energetic particles observed near the earth appear to be accelerated predominantly in the interplanetary shocks. The interplanetary shock speeds are lower and the longitudinal extents considerably less than those of flare-associated shocks. Three of the events were associated with unusual enhancements of singly ionized helium in the solar wind following the shocks. These enhancements appear to be direct detections of the cool filaments material expelled from the corona. It is suggested that these events are part of a spectrum of solar-eruptive events which include both weaker events and large flares. Despite their unimpressive and unreported solar signatures, the quiescent filament eruptions can result in substantial space and geophysical disturbances.

28314 (AD-A—188431/1/XAB) Summary of the cosmic-ray intensity during the solar-terrestrial events of 16 February and 24-28 April 1984. Shea, M.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jul 1987. 3p. (AFGL-TR—87-0277). NTIS, PC A02/MF A01.

Pub. in Solar-Geophysical Activity Reports for STIP Interval XV 12-21 February 1984 Ground Level Event and STIP Interval XVI 20 April-4 May 1984 Forbush Decrease, 153-154 Jul 1987.

A brief summary is presented of the ground-level solar cosmic-ray event on 16 February 1984 and of the Forbush decrease in cosmic-ray intensity associate with the flare of 24 April and subsequent geomagnetic disturbance on 26-28 April 1984.

28315 (AD-A—188432/9/XAB) Overview of solar-terrestrial physics phenomena for STIP Interval XV (12-21 February 1984) and STIP Interval XVI (20 April-4 May 1984). Shea, M.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jul 1987. 14p. (AFGL-TR—87-0278). NTIS, PC A03/MF A01.

Pub. in Solar-Geophysical Activity Reports for STIP Interval XV 12-21 February 1984 Ground Level Event and STIP Interval XVI 20 April-4 May 1984 Forbush Decrease, ix-xxi Jul 1987.

A summary of the significant solar-terrestrial events that occurred during STIP Interval XV (12 -21 February 1984) and STIP Interval XVI (20 April - 4 May 1984) is presented. The first period was highlighted by a large relativistic solar-particle event recorded at the earth on 16 February 1984. These particles were associated with a flare on the invisible hemisphere of the sun. The second period was highlighted by a major x-ray flare on 24 April 1984 with an associated geomagnetic distrubance on 25-26 April. This flare was associated with the release of solar neutrons - only the third time such an identification has been made.

28316 (AD-A—188433/7/XAB) Solar activity and heliosphere-wide cosmic-ray modulation in mid-1982. Cliver, E.W.; Mihalov, J.D.; Sheeley, N.R.; Howard, R.A.; Koomen, M.J. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1 Aug 1987. 17p. (AFGL-TR—87-0294). NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. A8, 8487-8501(1 Aug 1987).

A major episode of flare activity in June and July of 1982 was accompanied by a pair of heliosphere-wide cosmic-ray modulation events. In each case, a large Forbush decrease (FD) at earth was followed in turn by apparently related decreases at Pioneer 11 (P11) and Pioneer 10 (P10). White light coronagraph and near-sun satellite data are reviewed to identify plausible solar origins of these modulation events. The first widespread intensity decrease (FD 1) can be attributed to the combined effects of a backside flare from solar-active region 18382/18383, located 23 in ecliptic longitude from Pioneer 10, and a visible-disk flare from 18405 on June 6, when this region was 9 deg from Pioneer 11. The second widespread modulation event during this period (FD 2) may be linked to flares from active region 18474. Since even fast shocks would take about 1 month to propagate to Pioneer 11 (12 AU) and about 2 months to reach Pioneer 10 (28 AU) in mid-1982, these one-to-one associations must be regarded with caution. The processes of entrainment and coalescence can cause a given traveling interplanetary disturbance to lose its identity enroute to the outer heliosphere. The ability to identify plausible solar-flare candidates for each of the four Forbush-like decreases observed at the Pioneer satellites removes the need to invoke a shock from a single flare as the sole cause of either FD 1 (at both P10 and P11) or FD 2.

28317 (AD-A—188434/5/XAB) Rapid spectral and flux-time variations in a solar burst observed at various dm-mm wavelengths and at hard x rays. Vaz, A.M.; Kaufman, P.; Correia, E.; Costa, J.E.; Cliver, E.W. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1987. 16p. (AFGL-TR—87-0295). NTIS, PC A03/MF A01.

Pub. in Rapid Fluctuations in Solar Flares, 171-173(1987).

A solar burst was observed with high sensitivity and time resolution at cm-mm wavelengths by two different radio observatories with high spectral time resolution at dm-cm wavelengths by patrol instruments and at hard x rays. At the onset of the major burst time structure, there was a rapid rise in the spectral turnover frequency (from 5 to 15 GHz), in about 10s, coincident to a reduction of the spectral index in the optically thin part of the spectrum. The burst maxima were not time coincident at the optically thin radio frequencies and at the different hard x ray energy ranges. The profiles at higher radio frequencies exhibited better time coincidence to the higher-energy x rays. The hardest x ray spectrum (-3) coincided to peak radio emission at the higher frequency (44 GHz). The event appears to build up first by a major injection of softer particles followed by other injections of harder particles. Ultrafast time structures were identified as superimposed on the burst emission at the cm-mm high-sensitivity data and at x rays, with predominant repetition rates ranging 2.0-3.5 Hz.

28318 (AD-A—188474/1/XAB) Long-baseline astrometric interferometers. Report for January-December 1986. Staelin, D.H.; Shao, M.; Barrett, J.W.; Clark, L.D.; Holm, W. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Jan 1987. 4p. NTIS, PC A02/MF A01.

A counter-jet in the radio galaxy Cygnus A is discovered. This follows the earlier achievement of the discovery of the relativistic jet that emanates from the active galactic nucleus (a discovery

that was made through their new methods of image processing at the Very Large Array (VLA) at NRAO). A related project, a detailed polarization map of the radio galaxy, was also completed. A new observing project, one of the largest programs ever undertaken at the VLA, was begun to extend these methods to a larger selection of radio galaxies: searching for new gravitationally-lensed quasars. One prime example, Q0023+171, was discovered and six promising new candidate objects are being studied in greater detail. About 4000 radio maps, taken with the VLA, are being processed as part of their program. A successful series of VLBI experiments was conducted at 7-mm wavelength, with the intention of establishing that band for standard VLBI operations. A synthesized map at 7 mm of the active galaxy 3C84 (Perseus A) was prepared and represents the most highly detailed map ever made of that unusual object, with a resolution of 140 micr-arc-seconds.

28319 (AD-A—188578/9/XAB) Estimating cosmic-ray vertical cutoff rigidities as a function of the McIlwain L-parameter for different epochs of the geomagnetic field. Shea, M.A.; Smart, D.F.; Gentile, L.C. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1987. 8p. (AFGL-TR—87-0329). NTIS, PC A02/MF A01.

Pub. in Physics of the Earth and Planetary Interiors, Vol. 48, 200-205(1987).

The McIlwain L-parameter is commonly used to estimate cosmic-ray vertical cutoff rigidities. However, in some areas of the world, secular changes on the geomagnetic field between 1955 and 1980 have been large enough to produce significant differences in both the vertical cutoff rigidity and in the L value for specified positions. It is shown here that these changes are complementary, and that the relationship between the L value and the vertical cutoff rigidity is essentially invariant.

28320 (AD-A—188665/4/XAB) Plasma and magnetic-field properties of coronal loops observed at high spatial resolution. Webb, D.F.; Holman, G.D.; Davis, J.M.; Kundu, M.R.; Shevgaonkar, R.K. (Emmanuel Coll., Boston, MA (USA)). 15 Apr 1987. 15p. NTIS, PC A03/MF A01.

Pub. in Astrophysical Jnl., Vol. 315, 716-728(15 Apr 1987).

Compared are coordinated, high-spatial-resolution observations in soft x-rays-in microwaves at 1.45 GHz (20 cm) and 4.9 GHz (6 cm) and with photospheric magnetograms, of six coronal loops. The loops were found to have plasma parameters typical of quiescent active-region loops. Each loop had a compact microwave source with T/sub b/ = 1-2.5 million K cospatial with or near the loop apex. Contrary to some interpretations, no complete loops (as determined by the x-ray observations) were imaged in microwaves. Model loops using the derived observational plasma and magnetic parameters are constructed, and the predicted distribution of thermal microwave emission compared with observations. The loop emission observed at 4.9 GHz is best described by fourth harmonic gyroresonance emission from a dipole loop model, but with less field variation along the loop than in another model. The 1.45-GHz emission is likely to be free-free, since the x-ray loops are optically thick to free-free emission. The modeling results require the existence of an external plasma around the x-ray loops with a temperature of about 100,000 K or less. One can also deduce or place constraints on the magnetic field strengths within and their variations along the loops.

28321 (AD-A—188692/8/XAB) Solar flares and magnetic topology. Sturrock, P.A. (Stanford Univ., CA (USA). Center for Space Science and Astrophysics). Oct 1987. 15p. (CSSA-ASTRO—87-15). NTIS, PC A03/MF A01.

This article is a very brief review and comparison of the observational properties of flares and theoretical concepts of models of flares, especially the concepts of magnetic topology and its evolution. The environmental aspects of flare behavior are examined. Some of these aspects must be consequences of unknown processes occuring below the photosphere. Other aspects involve structures--such as filaments--that are closely related to flares. The author then examines properties of flares to try to distinguish the different phases of energy release that can occur in the course of a flare. Finally a schematic scenario is offered to interpret these phases in terms of this scenario.

28322 (AD-A—188752/0/XAB) Activity associated with the solar origin of coronal mass ejections. Webb, D.F.; Hundhausen, A.J. (Emmanuel Coll., Boston, MA (USA)). 1987. 20p. NTIS, PC A03/MF A01.

Pub. in Solar Physics Vol. 108, 383-401(1987).

Solar coronal mass ejections (CMEs) observed in 1980 with the HAO Coronagraph/Polarimeter on the Solar Maximum Mission (SMM) satellite are compared with other forms of solar activity that might be physically related to the ejections. The solar phenomena checked and the methods of association used were intentionally patterned after those of Munro et al.'s (1979) analysis of mass ejections observed with the Skylab coronagraph to facilitate comparison of the two epochs. Comparison of the results reveals that the types and degree of CME associations are similar near solar-activity minimum and maximum. For both epochs, most CMEs with associations had associated eruptive prominences and the proportions of association of all types of activity were similar. A high percentage of association between SMM CMEs and x-ray long-duration events (LDEs), in agreement with Skylab results. Most CMEs are the result of the destabilization and eruption of a prominence and its overlying coronal structure, or of a magnetic structure capable of supporting a prominence.

28323 (AD-A—188764/5/XAB) Atomic hydrogen and solar Lyman-alpha flux deduced from STP 78-1 uv observations. Anderson, D.E.; Paxton, L.J.; McCoy, R.P.; Meier, R.R. (California Univ., Berkeley (USA). Space Sciences Lab.). 1 Aug 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. A8, 8759-8766(1 Aug 1987).

Simultaneous observations of the Lyman-alpha and 1026-A airglow by a spectrometer on the STP 78-1 satellite were analyzed. A spherical model of a multiple scattering of solar Lyman-alpha and Lyman-beta radiation was utilized that nonisothermal temperature profile. Analysis of the data near 0 latitude yields an exobase density N/sub c/ = 26000 + or - 2000/cu cm^{-3}, and escape flux F/sub c/ = 2 + or - 0.5 x 10^{8}/sq cm/s. The solar Lyman-alpha line center flux determined from analysis of the Lyman-alpha airglow was 6.0 + or - 1.2 x 10^{11} photons/sq cm/sA. Analysis of the 1026-A airglow showed that this emission is dominated by multiple scattering of solar Lyman-beta photons by atomic oxygen and that the Lyman-beta airglow contributes less than 20% to the observed emission.

28324 (AD-A—188802/3/XAB) Revised standard format for cosmic-ray ground-level event data. Shea, M.A.; Smart, D.F.; Humble, J.E.; Fluckiger, E.O.; Gentile, L.C. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1987. 5p. (AFGL-TR—87-0284). NTIS, PC A02/MF A01.

Pub. in International Cosmic Ray Conference (20th), Vol. 3, 171-174(1987).

A revision to the suggested standard format for the exchange and archiving of cosmic-ray ground-level event data is presented.

28325 (IAE—4405/1) Is the 3C273 quasar mach nearer?. Kotel'nikov, G.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702235/JAW.

Effect of "superlight" expansion of some quasars resulting from cosmologic interpretation of red shift is considered. Possibility of determining distance to 3C273 quasar, taking account of its expansion angular velocity in frames of Doppler interpretation of quasar red shift value, is discussed. 26 refs.; 4 figs; 3 tabs.

28326 (ITF—86-137) Magnetohydrodynamic wave propagation in the solar wind. Malovichko, P.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702411/JAW.

Magnetohydrodynamic wave propagation in the solar wind is investigated. The wave decrement and amplitude dependence of heliocentric distance is obtained. It is shown that the wave damping

has essential influence on the index of wave spectrum, generated near the Sun. 15 refs.; 4 figs.

28327 (ITF—87-22) Interpretation of the polarimetric observations of Jupiter. Mishchenko, M.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702414/JAW.

The analysis of the ground based polarimetric observations of Jupiter is represented. Some properties of aerosol component of the upper cloud layer are established: the effective radius of the cloud particles if r/sub eff/=0.385+-0.030 μm, real part of the relativistic index if n/sub r/=1.386+-0.005. The results are obtained by means of polarization calculations with multiple scattering taken into account. 28 refs.

28328 (ITF—87-25) Distribution of hydroxyl clouds in the Galaxy. Yurevich, L.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702415/JAW.

Distribution of molecular clouds in the Galaxy is investigated on the base of survey of the galactic plane in hydroxyl lines at 1665 and 1667 MHz. The cloud distances are due to a relationship between hydroxyl absorption feature parameters and heliocentric distances. Radial distributions of the molecular clouds in four galactocentric quadrants have been obtained. Concentration of OH clouds into a molecular ring agrees with the radial distribution of CO and CH interstellar molecules in the Galaxy. It is shown that hydroxyl cloud complexes distribution can be represented by a two-armed spiral with pitch angles of 6/sup 0/.3 and 5/sup 0/.4. 25 refs.; 8 figs.

28329 (ITF—87-27) Polarization of light reflected by vertically inhomogeneous planetary atmosphere. Mishchenko, M.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702416/JAW.

The computational method is proposed for calculating the reflection matrix for a plane-parallel vertically inhomogeneous isotropic atmosphere. The method is based on the numerical solution of the initial value problem for the reflection matrix. The expansion is generalized spherical functions of the element of the scattering matrix is discussed. 32 refs.

28330 (NBI-HE—87-86) New possibility of cosmological model construction in Kaluza-Klein theories. Berezin, V.A.; Kuzmin, V.A. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). (Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Dec 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753285/JAW.

We studied the dimensional reduction of the 5-dimensional Schwarzschild-deSitter solution and found that the Friedmann-Robertson-Walker cosmological model may be obtained by the dimensional reduction along the Killing vector in the T-region of the 5-manifold. For the Appelquist-Chodos reduction we observed the universal behaviour of the scale factor near the 4-dimensional singularity and found a possibility of cosmological model constructing with induced singularity like the Big Bang from non-singular 5-dimensional solution.

28331 (PB—88-158910/XAB) Solar-Geophysical Data Number 519, November 1987. Part 2 (comprehensive reports). Data for May 1987, and miscellanea. Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Nov 1987. 66p. (SGD—519-PT-2). NTIS, PC A04/MF A01.

See also PB—88-158928, and PB—88-128434.

;Contents: Detailed index for 1987; Data for May 1987 – (Meudon carte synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Active prominences and filaments).

28332 (PB—88-158928/XAB) Solar-Geophysical Data Number 519, November 1987. Part 1 (prompt reports). Data for October, September 1987, and late data. Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Nov 1987. 128p. (SGD—519-PT-1). NTIS, PC A07/MF A01.

See also PB—88-158910, and PB—88-128426.

Contents include: Detailed index for 1987; Data for October 1987 – (IUWDS alert periods (Advance and worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field); Data for September 1987 – (Solar-active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Geomagnetic indices, Radio propagation indices); Late data – (Cosmic-ray neutron monitor, Geomagnetic indices, Calcium plage data March-April 1987, Kitt peak magnetograms 19 July-31 August 1987, Errata–sudden commencements/solar flare effects March 1986 and April 1987).

28333 (PB—88-164199/XAB) Solar-Geophysical Data Number 520, December 1987. Part 1 (Prompt reports). Data for November 1987, October 1987, and late data. Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Dec 1987. 100p. (SGD—520-PT-1). NTIS, PC A05/MF A01.

See also PB—88-164207, and PB—88-138078.

Contents include: Detailed index for 1987; Data for November 1987 – (IUWDS Alert Periods (Advance and worldwide), Solar-activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field); Data for October 1987 – (Solar-active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices); Late data – (Cosmic-ray neutron monitor Huancayo July 1987, Geomagnetic indices August - September 1987).

28334 (PB—88-164207/XAB) Solar-Geophysical Data Number 520, December 1987. Part 2 (Comprehensive reports). Data for June 1987, and miscellanea. Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Dec 1987. 30p. (SGD—520-PT-2). NTIS, PC A03/MF A01.

See also PB—88-164199, and PB—88-138060.

Contents include: detailed index for 1987; data for June 1987 – (meudon carte synoptique, solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from GOES satellite, mass ejections from the sun, active prominences and filaments).

28335 (PUBL-SER-C-FASC—14) Color-magnitude diagrams of star clusters in the Magellanic clouds from wide-field electronography. Part 3: NGC 1841. Andersen, J.; Blecha, A.; Walker, M.F. (Geneva Observatory (Switzerland)). 1987. 14p. (ETN—88-91108). NTIS, PC A03/MF A01.

The color-magnitude diagram (CMD) of NGC 1841, an outlying globular cluster in the Magellanic System, was constructed from electronographic photometry of 390 stars in the annular field R between 22 and 72', to a limit of V = 22.5. The detailed CMD confirms classifications of NGC 1841 as belonging to the oldest and most metal-poor population of the Magellanic System. For an adopted reddening of E (B-V) = 0.15, the CMD of NGC 1841 closely matches that of the galactic globular cluster M 92, indicating that the clusters are of similar age and metal abundance. The fit of the 2 CMDs yields a distance modulus to NGC 1841 of (m-M)o = 18.1 + or - 0.3. This places NGC 1841 within the disk system formed by the other old LMC clusters 10 kpc from the center of the LMC itself, in contrast to earlier results placing it well beyond the LMC. It also eliminates the discrepancy between the luminosities of its giant stars and similar Galactic globular cluster giants.

28336 (UCRL—98226) Spectral modelling of the soft gamma ray repeater. Liang, E.P. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 6p. (CONF-871245—5).

From Workshop on nuclear spectroscopy of astrophysical sources; Washington, DC, USA (14 Dec 1987).

This paper summarizes the results of numerical modelling of the spectra of the soft gamma ray repeater (SGR 1806-20). Parameters of the emission region can be extracted from the spectral fits under the simplistic assumption of isothermal and homogeneous emission layers. Limits on the luminosity distance of the source can also be derived if we make specific interpretations of the low frequency turnover in the observed spectrum. 12 refs., 3 figs.

28337 **Search for signals from Cygnus X-3 at energies above 50 TeV.** Dingus, B.L.; Chang, C.Y.; Goodman, J.A.; Gupta, S.K.; Krakauer, D.A.; Talaga, R.L.; Yodh, G.B.; Ellsworth, R.W.; Burman, R.L.; Butterfield, K.B.; and others. (University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* 60: No. 18, 1785-1788(2 May 1988).

Upper limits for the time-averaged flux of air showers from the direction of Cygnus X-3 during the calendar period 2 April 1986 to 3 May 1987 are found to be 1.5 x 10/sup -13/ cm/sup -2/ sec/sup -1/ for all events, and 7.6 x 10/sup -14/ cm/sup -2/ sec/sup -1/ for events with no observed muons in a 44-m^2 muon detector. These are integral fluxes above 50 TeV on the assumption of an E/sup -1/ primary spectrum. A possible observation of a short-term signal from Cygnus X-3, with an anomalous muon content, phase correlated with the 4.8-h orbital period, with an integral flux above 50 TeV of (8.2 +- 2.0) x 10/sup -13/ cm/sup -2/ sec/sup -1/ is also reported.

28338 **Bounds on exotic-particle interactions from SN1987A.** Raffelt, G.; Seckel, D. (Astronomy Department, University of California, Berkeley, California 94720). *Physical Review Letters;* 60: No. 18, 1793-1796(2 May 1988).

The observation of a neutrino pulse from the supernova SN1987A constrains the production of light exotic particles in the proto neutron star. We derive a new bound on the axion decay constant, f/sub a/approx. >10/sup 10/ GeV. If right-handed (RH) neutrinos exist, the "RH Fermi constant" is G/sub RH/approx. <10/sup -4/G/sub F/, 2 orders of magnitude below laboratory bounds. The Dirac mass of ν/sub μ/ can be constrained below laboratory limits.

28339 **Axions from SN1987A.** Turner, M.S. (NASA/Fermilab Astrophysics Center, Fermilab National Accelerator Laboratory, Box 500, Batavia, Illinois 60510-0500). *Physical Review Letters;* 60: No. 18, 1797-1800(2 May 1988).

Axion emission from SN1987A by nucleon-nucleon axion bremsstrahlung is considered. On the basis of the neutrino observations the axion luminosity must be approx. <10/sup 53/ erg s/sup -1/. This occurs if (1) axions couple very weakly: m/sub a/approx. <0.75 x 10/sup -3/ eV; or (2) axions couple strongly enough to be "trapped" and radiated from an "axion sphere" with T/sub a/approx. <8 MeV: m/sub a/approx. >2.2 eV. In general, "axion trapping" occurs for m/sub a/approx. >0.016 eV. Our mass constraints are at best reliable to within a factor of ≃3.

28340 **Scalar-field fluctuations and the baryon asymmetry of the Universe.** Enqvist, K.; Ng, K.W.; Olive, K.A. (Research Institute for Theoretical Physics, University of Helsinki, Siltavuorenpenger 20C, SF-00170 Helsinki, Finland). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 8, 2111-2115(15 Apr 1988).

We consider the effects of scalar-field fluctuations produced during inflation on the baryon asymmetry of the Universe. The decay of squark and slepton fluctuations may generate a baryon asymmetry as in the Affleck-Dine scenario or fluctuations of more massive fields might inhibit or even wash away an asymmetry.

28341 **Quantum effects of interacting fields in the early Universe.** Hu, B.L.; Zhang, Y. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 8, 2151-2164(15 Apr 1988).

The effective-action formalism used by Hartle, Hu, Fischetti, and Anderson for treating particle production and back reaction of free fields near the Planck time in the early Universe is extended here to interacting fields. We consider a massive (m) self-interacting λphi^4 scalar field coupled (ξ) to a Friedmann-Robertson-Walker spacetime and study the effect of interaction on particle production and on the dynamics of the background geometry. A background-field splitting is introduced in the one-loop effective action which is calculated by perturbative expansions up to the second order in λ, m^2, and ξ. Ultraviolet divergences from the fluctuation field are removed by introducing counterterms via dimensional regularization. From the regularized effective action equations governing the effective geometry and the background field are derived and their solutions sought. We consider separately the conformal versus the nonconformal (ξ), and the massless versus the massive (m) cases. We also contrast the cases with or without the background field (chi) and those with or without interaction (λ). The dynamics of the scalar field and the scale factor and the probability of pair production in each case are calculated. In the discussion we present a qualitative explanation of these results, and draw the connection with related work. The classical limit of the present problem depicts the evolution of a Higgs field in curved space, its results being useful for the description of inflation and reheating processes in the grand-unified-theory epoch. The present problem is also the semiclassical limit of quantum cosmology. The results obtained here can be useful to tackling problems involving dynamical fields in curved space such as critical dynamics in the early Universe.

28342 **Microprocessor-controlled rotating shadowband radiometer.** Michalsky, J.J. Jr.; Berndt, J.L.; Schuster, G.J. (Battelle Pacific Northwest Lab., Richland, WA (USA)). pp 366-368 of Proceedings of the IRS '84: Current problems in atmospheric radiation. Fiocco, G. Hampton, VA; A. Deepak Publishing (1984). (CONF-8408135—).

From International radiation symposium; Perugia, Italy (21 Aug 1984).

Long-term solar radiation measurements can be difficult and expensive to make. Some fundamental measurements are the total horizontal, the diffuse horizontal, and the direct normal irradiance. Two instruments are usually used to measure two of these from which the third can be derived. The cost of a WMO first-class radiometric installation with a tracking pyrheliometer, horizontal pyranometer, and a mid-priced microprocessor-based data logger is U.S. $5500 to U.S. $7000, depending on the quality of the tracker. If a shadowband pyranometer is used instead of the tracking pyrheliometer, the cost is nearer the low end. Shadowbands and inexpensive trackers have to be adjusted often. Unattended operation for a month requires the higher-priced installation. Data logging has often been an unhappy situation, with problems of reliability or ease of data reduction the main concerns. With the new microprocessor-based loggers, reliability as well as cost have increased. At the Pacific Northwest Laboratory (PNL), the authors developed a microprocessor-based data logger/controller that they wed to another PNL-developed device: a movable shadowband radiometer. This combination, which promises to be an effective low-cost instrument for the reliable determination of three fundamental solar parameters, is described in this paper.

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REFER ALSO TO CITATION(S) 28313, 28314, 28315, 28319, 28323, 28332, 28333, 28367

28343 **(AD-A—187686/1/XAB) Simple model for the initial phase of a water plasma cloud about a large structure in space. Technical report.** Hastings, D.E.; Gatsonis, N.A.; Mogstad, T. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Aeronautics and Astronautics). 4 May 1987. 39p. (SCIENTIFIC—1). NTIS, PC A03/MF A01.

Large structures in the ionosphere will outgas or eject neutral water and perturb the ambient neutral environment. This water can undergo charge exchange with the ambient oxygen ions and form a water plasma cloud. Additionally, water dumps or thruster firings can create a water plasma cloud. A simple model for the evolution of a water plasma cloud about a large space structure is obtained. It is shown that if the electron density around a large space is substantially enhanced above the ambient density then the plasma cloud will move away from the structure. As the cloud moves away it will become unstable and will eventually break up into filaments. A true steady state will exist only if the total elec-

tron density is unperturbed from the ambient density. When the water density is taken to be consistent with Shuttle based observations the cloud is found to slowly drift away on a timescale of many tens of milliseconds. This time is consistent with the Shuttle observations.

28344 (AD-A—187687/9/XAB) USU (Utah State University) Center of Excellence in theory and analysis of the geoplasma environment. Annual report, 1 October 1986-30 September 1987. Schunk, R.W. (Utah State Univ., Logan (USA). Center for Atmospheric and Space Sciences). 30 Oct 1987. 46p. NTIS, PC A03/MF A01.

The overall goal of the research is to obtain a better understanding of the basic chemical and physical processes operating in the geoplasma environment, including the ionosphere, thermosphere, and magnetosphere. Some of the specific tasks include the following: (1) Studies of ionospheric structure and irregularities; (2) Study the feasibility of developing better operational ionospheric models for the Air Force; (3) Conduct model/data comparisons in order to validate the ionospheric models; (4) Study plasma convection characteristics in the high-latitude ionosphere; (5) Study magnetosphere-ionosphere coupling problems; (6) Construct a thermospheric general circulation model; (7) Develop a 3D, time-dependent model of the outer plasmasphere; (8) Develop a 3D, time-dependent MHD model of the earth's magnetosphere; (9) Conduct satellite drag studies; and (10) Study certain spacecraft-environment interaction problems, including those related to high-voltage power sources, spacecraft outgassing, and spacecraft charging at LEO altitudes.

28345 (AD-A—187888/3/XAB) Collaborative studies of polar-cap ionospheric dynamics. Final report, 10 June 1983-30 September 1985. Meriwether, J.W.; Killeen, T.L. (Michigan Univ., Ann Arbor (USA). Dept. of Atmospheric and Oceanic Science). 12 Oct 1987. 45p. NTIS, PC A03/MF A01.

An important parameter in the modeling of polar-cap ionospheric phenomena relating to scintillations and small-scale irregularities is the thermospheric wind. The magnitude and direction of the flow of the neutral atmosphere determines how quickly these features of the polar-cap morphology develop and grow. The AFGL contract was awarded to support the construction and installation of an automatic instrument designed to observe automatically thermospheric winds and temperatures at Thule Air Base in Greenland. The observatory was successfully operated throughout the 1985/1986 winter between early December 1985 and 1 April 1986. This report presents the description of the instrumentation and a set of plots showing the reduced set of observations for the clear nights in this period.

28346 (AD-A—188058/2/XAB) Upper-thermospheric observations and neutral-gas dynamics at high latitudes during solar maximum. Doctoral thesis. Tschan, C.R. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1987. 316p. (AFIT/CI/NR—87-135D). NTIS, PC A14/MF A01.

The objective of this theses was to understand the neutral-gas dynamics in the high-latitude regions of the Earth's upper thermosphere. An understanding of the morphology of the neutral winds and the forces that drive or modify them. A unique 70-orbit December solstice data set was established, which included satellite neutral winds and other supporting data from Dynamics Explorer 2 (DE-2), with coverage of both polar caps during the same orbit. Analysis of these data led to the characterization of four basic high-latitude neutral-wind signature categories for each hemisphere under various interplanetary-magnetic-field (IMF) configurations. Furthermore, sunward neutral winds on the duskside of the polar cap, resulting from the mapping of the twin-cell ion convection onto the neutral gas through ion-neutral collisions, were well established in all cases. However, the dawnside sunward neutral winds were not as well established. The existence of a small region of dawnside neutral winds was noted in the winter northern hemisphere, but was usually absent in the summer southern hemisphere. Analysis of the individual neutral gas forces for solar-maximum December-solstice from the NCAR thermospheric general circulation model (TGCM), led to the realization that the polar-cap pressure gradient force in the winter northern hemisphere had a different orientation than in the summer southern hemisphere, resulting in the observed dawnside neutral-wind signatures. The variations in the orientation of the polar-cap-pressure gradient forces in opposite hemispheres were ascribed to temperature gradients, resulting from a superposition of solar EUV, Joule and cusp heating, as well as density variations.

28347 (AD-A—188126/7/XAB) Deviations from the average patterns of auroral-ion precipitation. Redus, R.H.; Gussenhoven, M.S.; Hardy, D.A.; Brautigam, D.H. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1988. 7p. (AFGL-TR—88-0004). NTIS, PC A02/MF A01.

Pub. in SPI Conference Proceedings and Reprint Series, Vol. 7(1988).

Precipitating ion spectra from two DMSP/F6 auroral passes during periods of Kp =0 are compared with those from statistically compiled maps. The comparison shows excellent agreement at low (diffuse aurora) latitudes, indicating well-ordered, long-time-scale dynamics, and lesser agreement in the high-latitude regions indicating higher temporal/spatial variability. Precipitating ions were measured throughout the diffuse and discrete aurora and in the polar cap during polar-cap arcs. The characteristics of the diffuse or low-latitude ion precipitation result from a combination of adiabatic plasma convection from the tail and the formation of Alfven layers near Earth. The mechanisms for high-latitude ion transport and precipitation are open to question.

28348 (AD-A—188190/3/XAB) Theoretical and observational problems with holes in the far-uv dayglow. Final report. Meier, R.R.; Chubb, T.A. (Naval Research Lab., Washington, DC (USA)). 5 Nov 1987. 9p. (NRL—9078). NTIS, PC A02/MF A01.

Results of an O I 1304A radiative-transfer model indicate that it is highly unlikely that holes in the Dynamics Explorer-1 (DE-1) dayglow observations are caused by either absorptive material imbedded in the atmosphere or to a depletion of atomic oxygen in an atmospheric column. An alternative explanation of absorbing clouds between the spacecraft amd the emitting atmosphere is not precluded by the theory. In addition, observations from a far-UV experiment on Orbiting Geophysical Observatory-4 (OGO-4) are examined for events comparable to the DE-1 holes. Some 200 events would be expected from the OGO-4 N2 Lyman-Birge Hopfield (LBH) band data if the holes are atmospheric phenomena lasting on the order of minutes. Alternatively, if the holes are the result of passage of absorbing clouds across detector fields of view, 30 events would have been expected in OGO-4 data; however, their short occurrence time would make them difficult to detect, on the average. No evidence of holes was found in the OGO-4 data.

28349 (AD-A—188237/2/XAB) Observation of suprathermal-electron fluxes during ionospheric modification experiments. Fejer, J.A.; Sulzer, M.P. (California Univ., San Diego, La Jolla (USA). Dept. of Electrical Engineering and Computer Sciences). 1 Apr 1987. 5p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. A4, 3441-3444,(Apr 1987).

The temporal behavior of backscatter by ionospheric Langmuir waves was observed with the 430-MHz radar at Arecibo while a powerful HF wave was cycled 2 s on, 3 s off. The time resolution was 0.1 s. Late at night, in the absence of photoelectrons, using an HF equivalent radiated power of 80 MW at 3. 175 MHz, the initial enhancement of about 6% above system noise of the backscattered power with Doppler shifts between -3.75 and -3.85 MHz was reached about 0.25 after switching on the HF transmitter. In the following second the enhancement gradually decreased to about 3% and remained there until switching off. During the late afternoon, in the presence of photoelectrons, using the same HF power at 5.1 MHz, an initial enhancement by 25% of the backscattered power with Doppler shifts between -5.25 and -5.35 MHz appeared within less than 0.1 s after switching on the HF transmitter. The incoherent backscatter by Langmuir waves enhanced by photoelectrons was already above system noise by a factor greatly in excess of 10 before switching on the HF transmitter; the 25% enhancement thus corresponds to an enhancement greatly in excess of 250% above system noise. The enhancement drops to less than one tenth of its original value in less than a second. The nighttime

effect is attributed to multiple acceleration of electrons from the high-energy tail of the Maxwellian distribution. The daytime effect is believed to be due to a modification in the distribution function of photoelectrons.

28350 (AD-A—188299/2/XAB) High-altitude chemical-release systems for Project BIME (Brazilian Ionospheric Modification Experiments) Project IMS (Ionospheric Modification Studies) Project PIIE (Polar Ionospheric Irregularities Experiment) Project Polar Arcs. Final report, 30 September 1981-30 June 1987. Stokes, C.S.; Murphy, W.J. (Franklin Research Center, Elverson, PA (USA)). 31 Jul 1987. 61p. NTIS, PC A04/MF A01.

Project BIME, a Spread-F observation program involved the launching of two Nike-Black Brant rockets each containing a payload containing Ammonium Nitrate Fuel Oil (ANFO). The rockets were launched from Barriera Do Inferno Launch Site in Natal, Brazil in August of 1982. Project IMS, an F-layer modification experiment involved three launch vehicles. A Nike-Tomahawk and two Sonda III rockets. The Nike-Tomahawk carried a sulfur hexafluoride (SF_6) payload. One of the Sonda III rockets carried a payload that consisted of an SF_6 canister and a samarium/strontium thermite canister. The remaining Sonda III carried a payload that consisted of a trifluorobromo methane (CF_3Br) canister and a samarium thermite canister. The rockets were launched from Wallops Island Launch Facility, Virginia in November of 1984. Project PIIE and Polar Arcs, a program to investigate polar ionospheric irregularities, involved the launch of a Nike-Black Brant rocket which housed one samarium thermite canister and six barium canisters. An attempted launch of the payload was returned in March of 1985, however, launch criteria could not be met and the payload was returned to FRC for storage and refurbishment for launch in 1987. The rocket was launched successfully from Sondrestrom Air Base, Greenland in March of 1987.

28351 (AD-A—188397/4/XAB) Mesospheric minor-species determinations from rocket and ground-based i.r. measurements. Ulwick, J.C.; Baker, K.D.; Baker, D.J.; Steed, A.J.; Pendleton, W.R. (Utah State Univ., Logan (USA)). 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Atmospheric and Terrestrial Physics, Vol. 49, No. 7/8, 855-862(1987).

A wealth of ground-based, balloon and rocket measurements of the airglow hydroxyl (OH) emission was accumulated by various experiments. Indeed, since the first-reported rocket observations (HEPPNER and MEREDITH, 1958), there have been over 50 rocket flights from which OH emission profiles have been reported (BAKER and STAIR, 1987). The sensors initially measured in the visible range (PACKER, 1961) and later in the infrared (LOWE, 1960; BAKER, 1978). Models were constructed of the photochemistry (MOREELS et al., 1977; BATTANER and LOPEZ-MORENO, 1979) and of the vertical-species transport in an attempt to fit the measured hydroxyl radiance variations. However, uncertainties exit in quenching-rate coefficients, radiation-transition probabilities and number densities of participating species, such that results are not conclusive (COXON and FOSTER, 1982; DUPUIS et al., 1986). As part of the overall investigation of neutral atmospheric dynamics of the middle atmosphere and to investigate the excitation processes of the night airglow, a coordinated rocket and ground-based measurement program was conducted as part of the MAP/WINE campaign to observe simultaneously several key parameters.

28352 (AD-A—188402/2/XAB) Latitude dependence of cosmic-ray cutoff-rigidity variations during the initial phase of a geomagnetic storm. Flueckiger, E.O.; Smart, D.F.; Shea, M.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1987. 5p. (AFGL-TR—87-0287). NTIS, PC A02/MF A01.

Pub. in International Cosmic Ray Conference (20th), No. 4, 216-219(1987).

This paper presents a study on the cosmic-ray cutoff-rigidity variations over Europe during the initial phase of the 17/18 December 1971 geomagnetic storm. Cutoff-rigidity changes deduced from neutron-monitor measurements are compared to results obtained by tracing cosmic-ray trajectories in a model of the perturbed geomagnetic field. It is demonstrated that about 1 hour after the storm sudden commencement at 1418 UT on 17 December 1971 the cosmic ray cutoff rigidities over Europe were increased. Due to the dominating effect caused by the magnetopause currents the increases had a significant amplitude of about 0.3 GV at high latitudes whereas at middle and low latitudes they were only of the order of 0.1GV or less.

28353 (AD-A—188592/0/XAB) Electric fields in earth orbital space. Magnetospheric structural dynamic response to external variables. Annual report, October 1986-November 1987. Olson, W.P.; Pfitzer, K.A. (Lawrence Berkeley Lab., CA (USA). Center for X-Ray Optics). Nov 1987. 22p. NTIS, PC A03/MF A01.

It is known that the magnetosphere responds dynamically to changes in the interplanetary magnetic field (IMF). Instead of qualitative reconnection theory (which the authors believe is basically incorrect), they examined this response in terms of electromagnetic wave propagation in the interplanetary region. They suggest that the interplanetary plasma (solar wind) is magnetized by the solar magnetic-sector structure. Electromagnetic waves of high frequency can propagate through the solar wind without appreciable attenuation. It is the interaction of these disturbance waves with the magnetosphere that causes the observed magnetospheric response to the IMF. The authors examined quantitatively the propagation of electromagnetic disturbances in the interplanetary region and their interaction with the magnetosphere. Only certain modes propagate and there are further restrictions on the waves at the magnetopause. They show that a southward turning wave enters the tail of the magnetosphere and weakens the magnetic field in the plasma sheet. A northward turning wave increases the field. This report presents the implications of these waves on substorm dynamics.

28354 (AD-A—188599/5/XAB) Spectrophotometric remote sensing of the diffuse aurora. Final report, 1 August 1979-30 November 1987. Vondrak, R.R.; Robinson, R.M. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). 30 Nov 1987. 20p. (LMSC/D—068460). NTIS, PC A03/MF A01.

Auroral electron precipitation produces both E-region ionization and bremsstrahlung x rays. In a set of coordinated observations, these atmospheric effects of electron precipitation were measured simultaneously by the x ray sensor on the DMSP/F2 spacecraft and by the incoherent-scatter radar at Chatanika, Alaska. In all data sets there was good agreement between the locations of the x ray source regions and the regions of enhanced E-region ionization. Detailed comparisons were made between the measured and inferred altitude profiles of ionization for two auroral conditions, a premidnight auroral band and a sunlit diffuse aurora. These comparisons validate the ability to infer auroral ionization from satellite-based x ray measurements.

28355 (AD-A—188724/9/XAB) Stimulated Emission of Energetic particles (SEEP). Final report for period ending 30 September 1987. Imhof, W.L.; Voss, H.D.; Mobilia, J.; Datlowe, D.W.; Gaines, E.E. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). 30 Nov 1987. 202p. (LMSC/D—068456). NTIS, PC A10/MF A01.

Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

An active satellite-ground coordinated space-plasma experiment was conducted in which electrons were precipitated from the radiation belts into the ionosphere by the controlled injection of VLF signals from ground-based transmitters. In this experiment Stimulated Emission of Energetic Particles (SEEP), four operational VLF transmitters were operated in special controlled formats at times of overpasses of the low-altitude polar- orbiting satellite S81-1. The results confirm the hypothesis that electrons can be precipitated from the radiation belts by ground-based VLF transmitters, and they provide information relating to the effects of such precipitation on the ionosphere. In addition, the precipitation of electrons by VLF waves associated with lightning was measured for the first time from a satellite. Many other important findings were made with the SEEP data. These include the following: 1) An assessment was made of the relative contributions of hiss, lightning, and VLF transmitter waves to electron precipitation from the slot region, 2)

discovery of the frequent occurrence of multiple peaks in the energy spectra of electrons trapped at low altitudes, 3) observation of electron pulsations near the trapping boundary, and 4) discovery of bremsstrahlung x-ray images of small isolated patches of energetic electron precipitation at high latitude.

28356 (AD-A—188875/9/XAB) Nonlinear evolution of the Kelvin-Helmholtz instability in the high-latitude ionosphere. Interim report. Keskinen, M.J.; Mitchell, H.G.; Fedder, J.A.; Satyanarayana, P.; Zalesak, S.T. (Naval Research Lab., Washington, DC (USA)). 21 Dec 1987. 69p. (NRL-MR—6043). NTIS, PC A04/MF A01.

The nonlinear evolution of the electrostatic Kelvin-Helmholtz instability, resulting from velocity-sheared plasma flows perpendicular to an ambient magnetic field, was studied including Pedersen conductivity effects (i.e., ion-neutral collisions). The Kelvin-Helmholtz instability develops in a distinctly different manner in the nonlinear regime with Pedersen coupling than without it. Specifically, the Pedersen coupling effects, in conjunction with a neutral wind and density gradient, (1) result in an increased time scale for Kelvin-Helmholtz instability wave growth, (2) inhibit Kelvin-Helmholtz vortex formation, (3) lead to nonlinear structures that can be described as breaking waves, and (4) generate, in the nonlinear regime, small-scale turbulence by means of secondary instabilities growing on the primary waves. The spatial power spectra of the electrostatic potential and density fluctuations, and it is found that there is a tendency for the potential and density to become shallower when Pedersen conductivity effects are included. The results are compared with recent Dynamics Explorer satellite observations of velocity sheared plasma flows in the high-latitude, near-earth space plasma and good agreement is found.

28357 (AD-A—188942/7/XAB) Observation of a hydromagnetic wave in the earth's magnetosphere. Master's thesis. Patterson, J.W. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1987. 78p. NTIS, PC A05/MF A01.

Measurements of a continuous hydromagnetic micropulsation event, which occurred in the pre-dawn magnetosphere on July 29, 1979, are reported as observed by wave and particle instruments onboard the P78-2 (SCATHA) spacecraft. Calculations of the Poynting vector make it clear that the wave is a traveling Alfven wave guided by the earth's magnetic field line. Plasma densities are calculated at L = 7. The phase relationship between the plasma flux and the electromagnetic fields is investigated. A self-consistent set of particle-density and particle-velocity data is determined, in order to verify the measurement of the electric field. Current magnetospheric models predicting Alfven-wave speeds, Alfven-wave periods and plasma densities are supported by the study.

28358 (INPE—3740) Dynamic of non relativistic electrons and protons in the plasmasphere. Mendes Junior, O.; Pinto Junior, O.; Gonzalez, W.D. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1985. 26p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702393/JAW.

A study of the dynamics of electrons and protons inside the plasmasphere is presented. These particles are subjected to the geomagnetic field and to plasmaspheric electric fields, given by simple static models, during magnetically quiet and disturbed periods.

28359 An integral model of plume rise from high explosive detonations. Boughton, B.A.; De Laurentis, J.M. (Sandia National Labs., Albuquerque, NM (USA)). pp 27-32 of Buoyant plumes. Davis, L.R.; Catton, I. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

A numerical model has been developed which provides a complete description of the time evolution of both the physical and thermodynamic properties of the cloud formed when a high explosive is detonated. This simulation employs the integral technique. The model equations are derived by integrating the three-dimensional conservation equations of mass, momentum and energy over the plume cross section. Assumptions are made regarding (a) plume symmetry; (b) the shape of profiles of velocity, temperature, etc. across the plume; and (c) the methodology for simulating entrainment and the effects of the crossflow induced pressure drag force on the plume. With these assumptions, the integral equations can be reduced to a set of ordinary differential equations on the plume centerline variables. Only the macroscopic plume characteristics, e.g., plume radius, centerline height, temperature and density, are predicted; details of the plume intrastructure are ignored. The model explicitly takes into account existing meteorology and has been expanded to consider the alterations in plume behavior which occur when aqueous foam is used as a dispersal mitigating material. The simulation was tested by comparison with field measurements of cloud top height and diameter. Predictions were within 25% of field observations over a wide range of explosive yield and atmospheric stability.

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REFER ALSO TO CITATION(S) 27742, 27819, 28656, 28726

28360 (AD-A—187919/6/XAB) Operators that move the nuclei of a molecule along paths of constant orbital energy. Wulfman, C.E. (Air Force Academy, CO (USA). Frank J. Seiler Research Lab.). 30 May 1986. 9p. (FJSRL-JR—86-0010). NTIS, PC A02/MF A01.

Pub. in Chemical Physics Letters, Vol. 127, No. 1, 26-32(30 May 1986).

One-parameter groups of operators that move the nuclei of a molecule along paths of constant orbital energy while appropriately transforming electronic eigenstates. Simple approximate operators that determine the functional form of level curves for $H_3(2+)$ illustrate the theory. Scale transformations are found to approximately convert the orbital isoenergetic curves of the ground state into those of two excited states of $H_3(2+)$.

28361 (AD-A—188064/0/XAB) Continuous stopping and trapping of neutral atoms. Bagnato, V.S.; Lafyatis, G.P.; Martin, A.G.; Raab, E.L.; Ahmad-Bitar, R.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 25 May 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Physical Review Letters, Vol. 58, No. 21, 2194-2197(25 May 1987).

Neutral-sodium atoms have been continuously loaded into a 0.1-K deep superconducting magnetic trap with laser light used to slow and stop them. At least 10^9 atoms were trapped with a decay time of 2 1/2 min. The fluorescence of the trapped atoms was studied as a function of time; possible loss mechanisms from the trap are discussed.

28362 (AD-A—188333/9/XAB) Gas-phase high-temperature photoelectron spectroscopy: an investigation of the transition metals scandium and vanadium. Dyke, J.M.; Gravenor, B.W.; Hastings, M.P.; Josland, G.D.; Morris, A. (Southampton Univ. (UK). Dept. of Chemistry). 1985. 12p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Electron Spectroscopy and Related Phenomena, Vol. 35, 65-75(1985).

The He(I) photoelectron spectra of atomic scandium and vanadium were recorded in the gas phase. For scandium, two bands associated with a 1/4s ionization and one band associated with a 1/3d ionization of the neutral atom were observed. Measurement of their relative intensities allows the sigma 3d: sigma 4s photoionization cross-section ratio in atomic scandium to be estimated as 57.1 + or - 9.0. In the atomic vanadium spectrum, six bands were seen. Four of these correspond to 1/3d and 1/4s ionizations of the ground state of the neutral atom, the V a 4F state, whereas two bands correspond to 1/3d ionizations of an excited state, the V a 6D state, which is approximately 2100/cm above the ground state. Measurement of the intensities of bands arising from the V a 4F state allows sigma 3d: sigma 4s to be estimated as 29.8 + or - 2.5 for vanadium. Spectra of vanadium were recorded with both single- and multi-detector photoelectron spectrometers. Comparison of the data-acquisition rates obtained with both spectrometers demonstrates the advantage of using a multidetector instrument in high-temperature photoelectron spectroscopy.

28363 (AD-A—188360/2/XAB) High-temperature photoelectron spectroscopy. A study of niobium monoxide and tantalum monoxide. Dyke, J.M.; Ellis, A.M.; Feher, M.; Morris, A.; Paul, A.J. (Southampton Univ. (UK). Dept. of Chemistry). 1987. 12p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Chemical Society, Faraday Trans. 2, Vol. 83, No. 8, 1555-1565(1987).

The He I photoelectron spectra of Nbo and TaO were recorded. In both cases, four main bands were observed that can be attributed to ionization of the isolated metal monoxide molecule. Bands associated with other oxides or the metal were not observed. Assignment of the photoelectron spectra of NbO and TaO was made with the aide of Hartree-Fock-Slater (HFS) calculations and by comparison with the known photoelectron spectrum of VO. The first adiabatic ionization energies of NbO and TaO were measured as 7.91 + or - 0.02 eV and 8.6 + or - 0.02 eV, respectively. Suggestions are made to explain the poor agreement between previous mass-spectrometric values for the first ionization energy of each oxide.

28364 (AD-A—188365/1/XAB) Correlations between photons in resonance fluorescence emitted by an atom near a metal surface. Technical report. Arnoldus, H.F.; George, T.F. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Oct 1987. 40p. (UBUFFALO/DC—87/TR-56). NTIS, PC A03/MF A01.

The photon correlations of resonance fluorescence emitted by a degenerate two-level atom near a metal surface are studied. An intense non-monochromatic optical laser drives a low-lying atomic transition, and the emitted fluorescence is detected by a photon counter. An expression for the spontaneous decay operator is derived, and it appears that the various substates of the upper level have a different lifetime due to the presence of the surface, or equivalently, due to the loss of spherical symmetry. The temporal photon correlation function is then evaluated in terms of a photon-emission operator and the time evolution operator for the atomic density matrix. The general theory is exemplified with a detailed elaboration of the j/sub g/ = 0 yields j/sub e/ = 1 transition, for which the two-photon correlation is obtained explicitly as a function of the lifetime A(h), depending on the atom surface distance h, the laser linewidth, the detuning from resonance, and the dipole-coupling strength with the external field.

28365 (AD-A—188436/0/XAB) Observation of three-body collisional transfer between atomic levels. Harris, M.; Kelly, J.F.; Gallagher, A. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). 1 Aug 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Physical Review A, Vol. 36, No. 3, 1512-1514(1 Aug 1987).

Collisional J-mixing rates between the J = 0,1,2 states of the Sr(5 3P sub J) multiplet were measured in the presence of rare-gas perturbers. For Kr and Xe pressures above 100 Torr, the rates are dominated by a component that is quadratic in pressure. This very unusual behavior is brought about by the aimultaneous interaction of a Sr atom with two perturbers and not by excimer formation.

28366 (AD-A—188904/7/XAB) Energy differences from electrostatic potentials at nuclei. Politzer, P.; Levy, M. (New Orleans Univ., LA (USA). Dept. of Chemistry). Oct 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Chemical Physics, Vol. 87, No. 8(15 Oct 1987).

The energy differences between atoms and between molecules that contain only one non-common atom can be expressed with a high degree of accuracy in terms of the electrostatic potentials at the non-common nucleus. The energy is given as a sum of terms, rather than a difference. In many instances, electrostatic potentials obtained from Hartee-Fock wave functions give energy differences more accurate than the Hartee-Fock delta E.

28367 (AD-A—188984/9/XAB) Neutral-beam propagation through the atmosphere. Final technical report, 1 June 1984-1 June 1987. Kalman, G.J.; Li, T. (Boston Coll., Chestnut Hill, MA (USA). Dept. of Physics). 15 Jun 1987. 41p. NTIS, PC A03/MF A01.

The problem of Beam Induced Stripping (BIS) process, occuring when a neutral beam propagates through the Earth's atmosphere, was analyzed. At high current densities, the process is important and leads to a rapid disintegration of the beam. At lower current densities currently contemplated for experiments, the effect is probably not significant.

28368 (CBPF-NF—027/87) About the correlation between atomic charge fluctuations in a molecule. Pitanga, P.; Giambiagi, M.S. de; Giambiagi, M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702216/JAW.

In this note, the features of the correlation between the electronic charge fluctuations of a pair of atoms within a molecule are analised. Through Schwarz's inequality for random operators in the Hilbert space, the softness of an atom in a molecule is related to its valence and to the softness of the other atoms. It is concluded that in the general case this correlation (from which in turn stems the chemical bond) in non-linear.

28369 (GSI—87-80(prepr.)) Percolation approach for atomic and molecular cluster formation. Knospe, O.; Seifert, G.; Schmidt, R. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik; Technische Univ., Dresden (German Democratic Republic). Sektion Physik; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ., Dresden (German Democratic Republic). Sektion Physik; Technische Univ., Dresden (German Democratic Republic). Sektion Physik; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Dec 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753240/JAW.

We apply a percolation approach for the theoretical analysis of mass spectra of molecular microclusters obtained by adiabatic expansion technique. The evolution of the shape of the experimental size distributions as function of stagnation pressure and stagnation temperature are theoretically reproduced by varying the percolation parameter. Remaining discrepancies between theory and experiment are discussed. In addition, the even-odd alternation as well as the 'magic' shell structure within metallic, secondary ion mass spectra are investigated by introducing statistical weights for the cluster formation probabilities. Shell correction energies of atomic clusters as function of cluster-size are deduced from the experimental data.

28370 (IC—87/216) Energy levels of the single excited states in NaI and Na-like ions. El-Sherbini, T.M.; Wahby, A.S. (International Centre for Theoretical Physics, Trieste (Italy); Alexandria Univ. (Egypt). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702245/JAW.

Energy levels of the single excited 1s/sup 2/2s/sup 2/2p/sup 6/ns(/sup 2/S), 1s/sup 2/2s/sup 2/2p/sup 6/mp(/sup 2/P), 1s/sup 2/2s/sup 2/2p/sup 6/md(/sup 2/D) and 1s/sup 2/2s/sup 2/2p/sup 6/nf(/sup 2/F); n=4-7, m=3-6 states for NaI and Na-like ions are calculated using the one configuration Hartree-Fock method. Good agreement is obtained between our results for the higher members of the NaI sequence and previous data from photo-absorption and beam foil experiments. (author). 11 refs, 3 figs, 9 tabs.

28371 (INIS-BR—1031) Effect of a laser field in the electron inelastic scattering into plasma fields. Hirata, D. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1986. 90p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702295/JAW.

A theory for calculating cross section of the electron ineslatic scattering process by an atom immersed in plasma and submitted to intense laser field was developed. The electrostatic shielding of plasma was considered in electron-electron interaction bound as in the electron-nucleus interaction. The formalism was applied for the study of 1s-2s and 1s-2p transitions in the hydrogen atom. The

effect of shielding is to diminish the cross sections, and the effect of laser field is to promote the scattering for energies below of the threshold of each transition. In the presence of laser the cross sections present characteristic oscillations of multiphoton process. (M.C.K.).

28372 (INIS-mf—11154) Auger emission from solid surfaces bombarded with ions. Grizzi, Oscar. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche; Universidad Nacional de Cuyo, Mendoza (Argentina). Inst. Balseiro). 1986. 188p. (In Spanish). NTIS (US Sales Only), PC A09/MF A01 - Comision Nacional de Energia Atomica, San Carlos de Bariloche (AR). Centro Atomico Bariloche. Order Number DE88702334/JAW.

The Auger electron emission from Be, Na, Mg, Al and Si bombarded with 0,5-20 KeV noble gas ions is studied. Sharp structures of the Auger electron spectra of Na and Be were identified. A Monte Carlo program was adapted to simulate the colision cascade in the solid, inner shell excitations and Auger decays. From the comparision of experimental and simulated Auger intensities, the relative role of symmetric and asymmetric collisions in Be K- and Al L-shell excitation were evaluated. In the case of Be, the discussion of the exciting processes to higher projectile energies was extended. To this end, the simulation to early measurements of Be K X-ray yields was applied. From this analysis, information about the variations of the fluorescence yield and outer-shell occupation numbers of Be with projectile energy was obtained. The study of the shape of the sharp Auger structures and their dependence with the energy and incidence projectile angle gives information about the collisional processes, inner hole lifetimes and Auger decays. From the evaluation of the energy and angular distribution of the excited sputtered atoms and the interaction between them and the metallic-surface, the energy shift distributions in the Auger energies were obtained. From the comparison of these distributions with the experimental atomic peaks, the main causes of the broadening of these peaks were determined. (M.E.L.).

28373 (INIS-mf—11205) Electron capture to autoionizing states of multiply charged ions. Mack, E.M. (Rijksuniversiteit Utrecht (Netherlands)). 17 Jun 1987. 250p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702382/JAW.

Contains summary in Dutch and previously published material.

The present thesis investigates electron capture reactions resulting from slow collisions (V << 1 a.u.) between multiply charged ions (A/sup q+/) and neutral gas targets (B). The energy spectra of the emitted electrons are measured; detection angle is 50/sup 0/. Mainly, autoionizing double capture resulting from collisions with two-electron targets (He, H/sub 2/) is studied; then, the emitted electrons stem from doubly excited projectile states. The projectiles used are bare C/sup 6+/, the H-like and He-like ions of C, N and O, He-like Ne/sup 8+/ and Ne-like Ar/sup 8+/. Excited metastable projectiles used are C/sup 5+/(2s), He-like projectiles A/sup q+/(1s2s/sup 3/S) and Ar/sup 8+/(...2p/sup 5/3s). Comparison is made with the predictions of a recently proposed extended classical barrier model, that was developed in connection with the work. This model assumes sequential capture of the electrons ('two-step' process); it predicts the realized binding enegies of the captured electrons - which may be directly determined from the autoionization spectra using only the projectile charge, the ionization potentials of the target and the collision velocity as parameters. No adjustable parameter enters into the calculations. The term energies and decay modes of the highly excited product ions themselves are studied. Generally, the autoionizing decay of these states is found to proceed preferentially to the directly adjacent lower singly excited state. Experimental evidence is presented, that triply excited states decay by successive emission of two electrons, whenever this is energetically possible. Finally, the L-MM decay in few-electron systems is considered. 314 refs.; 96 figs.; 29 tabs.

28374 (JINR-R—4-87-225) Variational calculation of weakly bound rotational-vibrational states of mesic molecules ddμ and dtμ. Korobov, V.I.; Puzynin, I.V.; Vinitskij, S.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702450/JAW.

Submitted to the journal Phys. Lett., B.

Variational calculations of energy levels of E/sub Jv/ and γ-factors of weakly bound rotational-vibrational states (J=1, v=1) of mesic molecules ddμ and dtμ, which are of main interest for last muon-catalysed fusion experiments are performed. The set of about 2000 basis functions has been used in calculations which has enabled us to obtain the most precise results: E/sub 11/(ddμ)=(-1.9750+0.0002) eV and E/sub 11/(dtμ=(-0.6604+0.0002) eV. 9 refs.; 4 tabs.

28375 (LYCEN—8719) Foil dissociation of 40-120 keV/p hydrogen clusters. Mazuy, B.; Belkacem, A.; Chevallier, M.; Gaillard, M.J.; Poizat, J.C.; Remillieux, J. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Apr 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753186/JAW.

We report on measurements of angular and charge state distributions of hydrogen fragments resulting from the dissociation of fast H/sub n//sup +/ clusters (n ≦ 13) in a carbon foil. The proximity effects on the fragment neutralization has been investigated for beam velocities above and around the Bohr velocity. At a given velocity the angular width and the yield of neutral atoms are observed to saturate at n ≧ 5 and n ≧ 7, respectively. The interpretation of these behaviours provides some insight on the collective aspects of the collisions and on the structure of hydrogen clusters.

28376 Effect of the nuclear motion on the electronic decay of core hole excited states in molecules. Murphy, R.; Lyo, I.; Eberhardt, W. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Journal of Chemical Physics;* **88**: No. 10, 6078-6081(15 May 1988).

We have measured the vibrational fine structure in the electronic decay spectrum of the N 1s→1π/sub g/ core electron excited state in molecular nitrogen. The Franck—Condon analysis of the vibrational substructure shows that within the 10^{-14} s lifetime of the core hole excited state the molecule adjusts to the excited state configuration, characterized by a change in bond length by 0.071 A. Interference effects due to the short lifetime of the intermediate state play only a minor role.

28377 Energy dependence of infrared emission from azulene C—H stretching vibrations. Shi, J.; Bernfeld, D.; Barker, J.R. (Department of Atmospheric, Oceanic and Space Sciences, Space Physics Research Laboratory, University of Michigan, Ann Arbor, Michigan 48109-2143). *Journal of Chemical Physics;* **88**: No. 10, 6211-6218(15 May 1988).

New data are described on the energy dependence of infrared fluorescence (IRF) from the C—H stretch modes (~3050 cm^{-1}) of vibrationally excited azulene ($C_{10}H_8$). An optoacoustic method was used to measure the absorbed laser energy and determine the number of excited molecules, while time-resolved infrared emission was recorded. The experimental uncertainties of ~5% are much smaller than in previous work and the agreement between the experiments and the theory for the IRF intensity is excellent for total vibrational energies from 14 000 to 33 000 cm^{-1}.

28378 Energy-dependent collisional deactivation of vibrationally excited azulene. Shi, J.; Barker, J.R. (Department of Atmospheric, Oceanic, and Space Sciences, Space Physics Research Laboratory, University of Michigan, Ann Arbor, Michigan 48109-2143). *Journal of Chemical Physics;* **88**: No. 10, 6219-6227(15 May 1988).

Collisional energy transfer parameters for highly vibrationally excited azulene have been deduced from new infrared fluorescence (IRF) emission lifetime data with an improved calibration relating IRF intensity to vibrational energy [J. Shi, D. Bernfeld, and J. R. Barker, J. Chem. Phys. 88, XXXX (1988), preceding paper].

In addition, data from previous experiments [M. J. Rossi, J. R. Pladziewicz, and J. R. Barker, J. Chem. Phys. 78, 6695 (1983)] have been reanalyzed based on the improved calibration. Inversion of the IRF decay curves produced plots of energy decay, which were analyzed to determine <ΔE>, the average energy transferred per collision. Master equation simulations reproduced both the original IRF decays and the deduced energy decays. A third (simple) method of <ΔE> determination agrees well with the other two. The results show <ΔE> to be nearly directly proportional to the vibrational energy of the excited azulene from ~8000 to 33 000 cm^{-1}. At high energies, there are indications that the <ΔE> energy dependence may be slightly reduced.

28379 Quantum scattering via the S-matrix version of the Kohn variational principle. Zhang, J.Z.H.; Chu, S.; Miller, W.H. (Department of Chemistry, University of California, and Material Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **88**: No. 10, 6233-6239(15 May 1988). Contract FG02-86ER13630.

The S-matrix version of the Kohn variational principle is used to obtain a very effective method for quantum scattering calculations. The approach is especially useful for the nonlocal (i.e., exchange) interactions that arise in chemically reactive scattering (and also in electron—atom/molecule scattering). The particular version developed in this paper has a more general structure than an earlier one by Miller and Jansen op de Haar [J. Chem. Phys. 86, 6213 (1987)], and applications to an elastic scattering problem, and also to three-dimensional $H+H_2$ reactive scattering, show that it is also more useful in practice.

28380 Rotationally resolved hot atom collisional excitation of CO_2 00°1 and 00°2 stretching vibrations by time-resolved diode laser spectroscopy. O'Neill, J.A.; Wang, C.X.; Cai, J.Y.; Flynn, G.W.; Weston R.E. Jr. (Department of Chemistry and Columbia Radiation Laboratory, Columbia University, New York, New York 10027). *Journal of Chemical Physics;* **88**: No. 10, 6240-6254(15 May 1988).

A tunable infrared diode laser has been used to monitor the time-resolved absorption of rovibrationally excited CO_2 molecules produced in collisions with fast hydrogen atoms from the 193 nm excimer laser photolysis of H_2S. Nascent relative rotational population distributions were measured for the 00°1 and 00°2 vibrational states in CO_2 following collisional excitation. The nascent distributions for both of these states were found to be significantly displaced from the 300 K Boltzmann distribution with peaks at J = 31 and J = 34 for 00°1 and 00°2, respectively. An approximate diffusion treatment for the mass transport of fast moving hydrogen atoms out of the region of the diode laser probe beam was developed and used to obtain approximate absolute scattering cross sections. Sufficient energy is available in the H/CO_2 collision process to excite 00°1 rotational states with J greater than 140. The fall-off in excitation probability for J>31 is ascribed to the small impact parameter necessary to produce vibrationally excited CO_2 (00°1). This in turn limits the total angular momentum available in those collisions which actually produce 00°1. These results are compared with previous experiments measuring the total probability for collisional excitation of all ν_3 quanta as well as with various models for inelastic collisional scattering.

28381 Sensitivity analysis of mass effects in rotational energy transfer. Kreutz, T.G.; Eno, L.; Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08544). *Journal of Chemical Physics;* **88**: No. 10, 6322-6334(15 May 1988).

This paper examines the sensitivity of rotationally inelastic integral state-to-state cross sections to variations in the masses of the collision partners. We investigate the helium-hydrogenic scattering system with its many physical isotopes and excellent ab initio potential. The collision dynamics are approximated by coupled states-exponential distorted wave (CS-EDW) theory and both cross sections and elementary sensitivity coefficients (partial derivatives of the cross sections with respect to the mass parameters) are calculated. In order to be able to properly interpret these results, we first generate conceptually and computationally simpler distorted wave (CS-DW) cross sections and elementary sensitivities. These perturbative results are analyzed using simple collisional concepts and models. In addition, we present functional forms which predict (or scale) the global behavior of DW cross sections through the mass parameter space. As a quantitative aid in linking EDW cross sections with the DW results, a new type of sensitivity coefficient is introduced which measures the sensitivity of a given EDW cross section to the variation of a single DW cross section or combination thereof.

28382 Excess electrons in polar molecular clusters. Barnett, R.N.; Landman, U.; Cleveland, C.L.; Kestner, N.R.; Jortner, J. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Journal of Chemical Physics;* **88**: No. 10, 6670-6671(15 May 1988).

Electron attachment and localization to water and ammonia clusters, $(NH_3)^-$/sub n/ and $(H_2O)^-$/sub n/ (n = 16—256), is studied using path-integral molecular dynamics simulations, employing an electron—molecule pseudopotential which includes Coulomb, polarization, exclusion, and exchange contributions. Due to the nature of the interactions the ammonia clusters do not form stable well-bound surface states for any size, in contrast to the case of medium size water clusters. The onset of bound excess electron states in ammonia clusters occurs for size n≧32, via an internal localization mode, in agreement with experimental data.

28383 Population of high—angular-momentum states in low-energy double-electron-capture collisions of O/sup 6+/ with He. Meyer, F.W.; Griffin, D.C.; Havener, C.C.; Huq, M.S.; Phaneuf, R.A.; Swenson, J.K.; Stolterfoht, N. (Oak Ridge National Laboratory, Physics Division, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **60**: No. 18, 1821-1824(2 May 1988). Contract AC05-84OR21400.

We report the first experimental study of the angular momentum states populated by double-capture collisions of multiply charged ions. High-resolution spectra of L-Coster-Kronig electrons originating from O/sup 4+/ $1s^2$2pnl (n = 6,7) states produced in 30—105-kev O/sup 6+/+He collisions were obtained. Analysis of the observed spectra, performed with use of Hartree-Fock transition energies, indicates population of high—angular-momentum states. A classical-model calculation suggests that the correlated transitions producing the $1s^2$2pnl autoionizing states involve both energy and angular momentum exchange between the two transferred electrons.

28384 Infrared—ultraviolet double resonance studies of benzene molecules in a supersonic beam. Page, R.H.; Shen, Y.R.; Lee, Y.T. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **88**: No. 9, 5362-5376(1 May 1988). Contract AC03-76SF00098.

We have used IR excitation to selectively create populations in admixtures of the zeroth-order states comprising the ~3000 cm^{-1} "C—H stretching Fermi triad" of benzene. UV spectra of the 260 nm A-italic-tilde($^1B_2$/sub u/)left-arrowX($^1A_1$/sub g/) transition in the IR-excited molecules show several new bands, which we have assigned. Final states in the UV transitions are some vibrational levels which have not been detected before, allowing us to find several excited-state vibrational frequencies. We have determined ν/sup '/$_3$ = 1327 +- 3 cm^{-1}, ν/sub 19/ = 1405 +- 3 cm^{-1}, and ν/sup '//sub 20/ = 3084 +- 5 cm^{-1}. Also, vibrational structure which was unresolved in IR spectra of the "Fermi triad" was resolved in the UV double resonance spectra, confirming that the C—H stretching admixture is really a tetrad. The 3048, 3079, and 3101 cm^{-1} states had formerly been given the labels ν"/sub 20/, ν/sup "/$_8$+ν"/sub 19/, and ν/sup "/$_1$+ν"$_6$+ν/sup "//sub 19/, respectively. Actually, the middle level most nearly resembles ν"$_1$+ν/sup "/$_6$+ν"/sub 19/, and the 3101 cm^{-1} level is strongly mixed with ν/sup "/$_3$+ν"$_6$+ν/sup "//sub 15/. As predicted by molecular orbital theory, excited-state C—H bending and stretching frequencies are not very different from those in the ground state.

28385 Variational sticking-fraction calculations for the ground state of the tdμ molecular ion. Haywood, S.E.; Monkhorst, H.J.; Szalewicz, K. (Quantum Theory Project, Department of Physics and Department of Chemistry, University of Florida, Gainesville, Florida 32611). *Physical Review [Section] A: General Physics;* **37**: No. 9, 3393-3398(1 May 1988).

We have used variational wave functions for the ground state of the tdμ molecular ion to find the probability that after the t-d fusion the system will be in a state with the muon bound to the α particle. This probability, known as the sticking fraction, was found to be 0.8860 x 10/sup -2/.

28386 Reactive scattering and electron detachment for collisions of halogen negative ions with HCl, DCl, and HBr. Champion, R.L.; Doverspike, L.D.; Huq, M.S.; Scott, D.; Wang, Y. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). *Journal of Chemical Physics;* **88**: No. 9, 5475-5480(1 May 1988).

Absolute total cross sections have been measured for collisions of Cl^-, Br^-, and I^- with HCl, DCl, and HBr for projectile energies ranging from 5 to 300 eV. The processes investigated include reactive scattering and electron detachment. The reactive scattering cross sections exhibit considerable isotope effects and the collisional dynamics are discussed within the framework of a spectator-stripping model which involves proton or deuteron abstraction. The results for the I^- projectile are substantially different from those for Cl^- and Br^-; this difference is suggested to be related to the relative stability of the molecular anion, HI^-.

28387 Partial cross sections for electron capture into specific n states for 0.1- and 0.25-MeV/nucleon I/sup q/$^+$-H_2 collisions (q = 12—18). Hippler, R.; Datz, S.; Krause, H.F.; Miller, P.D.; Pepmiller, P.L.; Dittner, P.F. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] A: General Physics;* **37**: No. 9, 3201-3203(1 May 1988). Contract AC05-84OR21400.

Partial cross sections for electron capture into specific n states are reported for 0.1- and 0.25-MeV/nucleon I/sup q/$^+$-H_2 collisions (q = 12—18). The measured cross sections show pronounced differences when compared to theoretical calculations based on a number of models for bare incident ions on atomic hydrogen.

28388 Quasimolecular x-ray spectroscopy for slow Cl/sup 16+/-Ar collisions. Schuch, R.; Meron, M.; Johnson, B.M.; Jones, K.W.; Hoffmann, R.; Schmidt-Boecking, H.; Tserruya, I. (Physikalisches Institut, Universitaet Heidelberg, D-6900 Heidelberg, Federal Republic of Germany). *Physical Review [Section] A: General Physics;* **37**: No. 9, 3313-3325(1 May 1988).

Quasimolecular x-ray transitions into the 1sσ orbital of the Cl/sup 16+/-Ar collision system were measured in coincidence with scattered particles for collision energies of 20, 10, 5, and 2.5 MeV. The acceleration-deceleration method was used to produce K-shell vacancy bearing projectiles at low velocities. Because K-shell vacancies were brought into the collisions, the excited states of the transient quasimolecules could decay by x-ray emission either on the incoming or on the outgoing parts of the collision trajectory. The resulting interference structures in the quasimolecular x-ray spectra are clearly observed for impact parameters between 600 and 3000 fm. The analysis of these spectra has produced the first experimental determinations of 2pπ-1sσ transition energies as a function of internuclear distance. Details of the experimental procedure, results, and analysis are presented; the velocity and impact-parameter dependencies of spectral decay widths are investigated; and the effects of collision broadening for quasimolecular x rays are discussed.

28389 Measurements of two-photon absorption cross sections for liquid benzene and methyl benzenes. Chen, C.H.; McCann, M.P. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6378). *Journal of Chemical Physics;* **88**: No. 8, 4671-4677(15 Apr 1988). Contract AC05-84OR21400.

Two-photon cross sections of neat benzene and methyl substituted benzenes at various wavelengths for selective excitation were measured by two-photon induced fluorescence spectra for the first time. The results show that the two-photon rate increases rapidly with the frequency of the photon.

28390 Classical path approach to reactive scattering. I. Use of hyperspherical coordinates. Muckerman, J.T.; Gilbert, R.D.; Billing, G.D. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **88**: No. 8, 4779-4787(15 Apr 1988). Contract AC02-76CH00016.

A classical path method is described for treating reactive collisions in three-body systems. The key feature of the method is the use of hyperspherical coordinates, which allow the definition of classical and quantum subsystems in such a way as to be independent of the arrangement of the particles. The "relative" motion and overall rotation are treated classically, while the "arrangement" and internal motion are treated quantum mechanically. The method is applied to the collinear D+HH system on the PK2 potential energy surface. These calculations show a great improvement over quasiclassical trajectory results in the vicinity of the apparent threshold of the reaction.

28391 Unusual degree of angular anisotropy in the resonant Auger spectrum of Kr. Carlson, T.A.; Mullins, D.R.; Beall, C.E.; Yates, B.W.; Taylor, J.W.; Lindle, D.W.; Pullen, B.P.; Grimm, F.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6201). *Physical Review Letters;* **60**: No. 14, 1382-1385(4 Apr 1988). Contract AC05-84OR21400.

The angular distribution parameter, β, has been measured for the resonant Auger spectra in Kr following 3d→5p excitation. Unusually low values, close to -1, were seen for two bands. From optical spectroscopy data these bands are assigned to the final states $4p^4(^3P)5p(^4P/sub\ 5/2/, {}^4P/sub\ 3/2/,$ and $^4D/sub\ 5/2/)$. According to angular momentum transfer theory, some of the transitions could be parity unfavored, yielding β values of -1, but additional theory is required for a complete understanding. Implications for angular studies of highly resolved Auger spectra are discussed.

28392 Laser-induced third harmonic generation in forbidden regions. Blazewicz, P.R.; Payne, M.G.; Garrett, W.R.; Miller, J.C. (Oak Ridge National Lab., Chemical Physical Section, Health and Safety Research Div., Oak Ridge, TN 37831-6125 (US)). pp 168 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper THGG 49.

The authors investigated in detail modifications of third harmonic generation by a second strong laser. The authors report the observation of tunable third harmonic light in the positively dispersive region on the low-energy side of the xenon 6s'[1/2]/sup 0//sub 1/state induced on introduction of a second strong laser field. They also report observations of strong systematic increases and decreases in ionization signals generated to the blue of the 6s' level. All our results are interpreted in terms of phase-matching changes induced by the second laser which affect third harmonic production and subsequent ionization of xenon atoms. In addition, they present theoretical expressions for the effect of a second laser field on third harmonic production and multiphoton ionization on both the positively and negatively dispersive sides of the three-photon resonances. The authors' treatment includes detailed analysis and calculation of the systematic changes in TH production and ionization yields induced by the second laser over the phase-matching profile in the negatively dispersive region.

28393 Theory of multiphoton ionization of atoms. Kulander, K.C. (Lawrence Livermore National Lab., Theoretical Atomic and Molecular Physics Group, Livermore, CA 94550 (US)). pp 202 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper FFF 3.

The theory of multiphoton ionization of multielectron atoms by very intense short-rise-time laser pulses for which perturbative treatments are invalid is being actively pursued. The explicit solution of the time dependent Schroedinger equation would provide a description of the preionization dynamics (PD). Since this approach is intractable, calculations using the time-dependent self-consistent field (TDSCF) method are being developed. The approximation involved is that each electron moves in the time-dependent-mean field of the other electrons in addition to the laser field, which is treated semiclassically, and the nuclear attraction. Part of the electron-electron correlation is neglected, but most of the important physics of PD can be included. These calculations can be performed for any pulse shape and, in particular, can show how laser energy is absorbed in the atom and how it is shared between the electrons. They address the questions of sequential vs direct multiple ionization and whether collective modes exist and play a role in the DPD. Preliminary results using the TDSCF method are presented. The effects of wavelength, pulse rise time, and peak laser intensity on the PD and on the ionization itself are discussed.

28394 Atomic physics experiments with stored cooled heavy ion beams. Datz, S. (Oak Ridge National Lab., TN (USA)). pp 3-10 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The wide ranging interest in the development of heavy ion synchrotrons with electron beam cooling is evident from the number of projects presently under way. Although much of the initial motivation for these rings stemmed from nuclear and particle physics, a considerable amount of atomic physics experimentation is planned. This paper surveys some of the new opportunities in atomic physics which may be made available with storage ring systems.

28395 Atomic physics at the Heidelberg test storage ring (TSR). Schuch, R. (Physikalisches Institut der Universitaet, Heidelberg (West Germany)). pp 11-17 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A brief description of the Heavy-Ion Test Storage Ring (TSR) presently being built at the Max-Planck Institut in Heidelberg is given. It will be able to store ions injected from the tandem postaccelerator combination up to ~ 30 MeV/nucleon for a charge to mass ratio of 0.5. One of the main purposes of the TSR will be the study of electron cooling. Some atomic physics experiments are discussed using the electron cooling device which provides an electron-ion collision facility with good energy resolution and ion beams of high currents and low emittances. Here the possibilities for measurements of spontaneous and laser-induced radiative recombination and dielectronic recombination in the electron cooling section are discussed.

28396 Heavy ion storage and cooler ring project ESR at GSI. Franzke, B. (GSI-Darmstadt (West Germany)). pp 18-25 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The Experimental Storage Ring ESR [1] is designed for accumulation, storage and cooling of heavy ion beams up to uranium with energies up to 500 MeV/u either directly out of the heavy ion synchrotron SIS [2] or via a stripper target, where electron-free or electron-poor ions are produced. The intense, cold beams may be used for a large variety of experiments, preferably in-ring experiments making use of the special features of the storage ring. Due to circulation frequencies of up to 2 MHz high luminosities will be attained using thin internal gas jet or electron target. Energies can be varied over a wide range from 500 MeV/u down to 3 MeV/u. The SIS/ESR-facility will also be capable of delivering beams of unstable nuclei produced by fragmentation or fission of heavy projectiles. After preselection in a large acceptance Z/A-separator the secondary beams can be prepared for internal or external experiments by stochastic precooling, intensity accumulation and final electron cooling.

28397 HISTRAP proposal: heavy-ion storage ring for atomic physics. Olsen, D.K.; Alton, G.D.; Datz, S.; Dittner, P.F.; Dowling, D.T.; Haynes, D.L.; Hudson, E.D.; Johnson, J.W.; Lee, I.Y.; Lord, R.S.; Ludemann, C.A. (Oak Ridge National Lab., TN (USA)). pp 26-37 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

HISTRAP, Heavy-Ion Storage Ring for Atomic Physics, is a proposed 46.8-m-circumference synchrotron-cooling-storage ring optimized to accelerate, decelerate, and store beams of highly charged very-heavy ions at energies appropriate for advanced atomic physics research. The ring is designed to allow studies of electron-ion, photon-ion, ion-atom, and ion-ion interactions. An electron cooling system will provide ion beams with small angular divergence and energy spread for precision spectroscopic studies and also is necessary to allow the deceleration of heavy ions to low energies. HISTRAP will have a maximum bending power of 2.0 T m and will be injected with ions from either the existing Holifield Heavy Ion Research Facility 25-MV tandem accelerator or from a dedicated ECR source and 250 keV/nucleon RFQ linac.

28398 Cooled ion beams for physics experiments. Mills, F.E. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 38-42 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Beam cooling methods developed for high energy colliders of protons and antiprotons are now finding application as media for experimentation in Nuclear and Atomic Physics. Two principal methods have been employed, stochastic cooling and electron cooling. The physics of these methods, and their ranges of applicability are discussed.

28399 Measurement of absolute cross sections for multielectron processes in slow collisions between highly charged ions and atoms. Cederquist, H.; Astner, G.; Barany, A.; Danared, H.; Johnson, A.; Liljeby, L.; Rensfelt, K.G.; Huldt, S.; Hvelplund, P.; Knudsen, H. (Research Institute of Physics, Stockholm (Sweden)). pp 43-47 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

In this experiment absolute cross sections for single and multielectron processes in slow collisions, A/sup q+/ + B → A/sup r+/ + B/sup s+/ + (r + s - q)e⁻, have been measured. By means of a coincidence time-of-flight techniques, the charge state of the projectile before and after the collision and the charge state of the

target after the collision are determined. The experimental techniques is discussed together with simple models for absolute cross sections.

28400 Multiple collision analysis of total cross sections for Ar-L and Mg-K vacancy production measured in slow Ar-Mg collisions. Cipolla, S.J.; Hicks, L.W. (Creighton Univ., Omaha, NE (USA)). pp 48-51 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Total vacancy production cross sections resulting from multiple collisions of 50-500 keV Ar/sup 2+,1+/ with Mg in thick targets were determined from the characteristic Mg-K and Ar-L X-ray yields measured with a gas-flow proportional counter. The cross sections were corrected for Ar-straggling, and the Mg-K vacancy production cross sections were further corrected for target-target recoil effects. The Ar-L vacancy production cross sections are compared with the cross sections calculated from $3d\delta^{+}$-$3d\pi^{+}$-$3d\sigma$ rotational coupling. The theoretically calculated $2p\pi$-$2p\sigma$ rotational coupling cross section is used to determine the equilibrium fraction of Ar-L vacancies in these collisions. The Mg-K and Ar-L results are used finally to determine the average lifetime and average fluorescence yield of the Ar-L vacancy.

28401 High resolution x-ray experiments. Deslattes, R.D. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 52-58 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Accelerators provide highly charged ions for a variety of experimental studies. In applications involving accurate high resolution spectroscopy, care is needed to keep Doppler corrections manageable and reduce satellite problems. Some aspects of the motivation for such work are reviewed along with techniques for trying to produce clean spectra.

28402 Ion-Induced x-ray studies with a high luminosity von Hamos crystal spectrometer. Vane, C.R.; Smith, M.; Raman, S.; Heard, J.; Walkiewicz, T. (Oak Ridge National Lab., TN (USA)). pp 59-63 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84OR21400.

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A high-resolution, high-efficiency, von Hamos geometry, Bragg crystal X-ray spectrometer has been developed and mounted on a beamline at the Holifield Heavy Ion Research Facility at the Oak Ridge National Laboratory. Measurements have been made of K and L X-rays emitted from a variety of targets and projectiles. Instrument performance characteristics are reported here along with spectra from fast projectile ions and very low intensity target emission - areas of measurement for which this spectrometer is especially suitable.

28403 L-Subshell ionization probabilities in very asymmetric ion-atom collisions. Schmidt-Boecking, H.; Ullrich, J.; Doerner, R.; Dexheimer, K.; Kelbch, S.; Dangendorf, V.; Schuch, R.; Zehendner, S.; Hagmann, S.; Baptista, G.B. (Universitaet Frankfurt (West Germany)). pp 64-68 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The L-subshell ionization probabilities have been measured as a function of the impact parameter for proton on Sm, He on Pt, and Ne on Yb and Pt. For the light ions at very low velocities, the experimental subshell ionization probabilities are in agreement with predictions of the SCA theory. For increasing velocity and increasing projectile nuclear charge, however, severe deviations between theory and experiment are observed. Possible reasons for these deviations could be an omission of collisional coupling between the L-substates, which is neglected in the SCA approach. For p on Sm also the impact parameter dependence of the L/sub III/ alignment tensor components have been measured. These alignment data also deviate strongly from predictions of the SCA theory.

28404 Ion-X-ray coincidence measurements in heavy ion collisions. Graham, W.G.; Bernstein, E.M.; Clark, M.W.; Tanis, J.A.; Berkner, K.H.; Schlachter, A.S.; Stearns, J.W.; Johnson, B.M.; Jones, K.W.; Meron, M.; McFarland, R.H. (Univ. of Ulster, Coleraine (Ireland)). pp 69-73 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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X-ray emission associated with projectile charge-changing events in fast ion-atom collisions can be used to isolate and investigate excitation, ionization and charge transfer, as well as combinations of these processes. The major emphasis to date has been on the study of two-electron processes. Several such processes have been studied in detail. Resonant and nonresonant transfer and excitation (RTE and NTE) occur when electron capture and projectile excitation, with stabilization by X-ray emission, take place together in a single collision. Loss and excitation (LE) occurs when a projectile electron is removed and the ion is excited in a single collision. The cross sections for loss and excitation have been measured for a wide range of highly stripped projectiles over a broad energy range. The results shed light on projectile K X-ray production processes in heavy-ion collisions. The use of ion-X-ray coincidence techniques in exploring these and other collision processes will be discussed.

28405 Anisotropy of L x-ray emitted from gold atoms aligned by proton impact ionization. Fou, C.M.; Liu, C.P.; Picut, R. (Univ. of Delaware, Newark (USA)). pp 74-76 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The L-X rays emitted from gold atoms impact-ionized by 65° scattered 1 MeV protons were measured at 0° and 90° relative to the normal of the reaction plane using a coincidence technique. The anisotropy determined is used to deduce roughly the degree of alignment due to the difference in the differential ionization cross section of absolute value of m/sub j/ = 1/2 and 3/2 magnetic substrates of the j = 3/2 state.

28406 L-Subshell ionization of Nd, Gd, and Er by 0.40 to 2.00 MeV incident deuterons. Rayburn, L.A.; Thompson, B.C. (Univ. of Texas, Arlington (USA)). pp 77-80 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Subshell X-ray production cross sections of Nd, Gd, and Er were measured for incident deuterons with energies between 0.40 and 2.00 MeV. These measurements are compared to theoretical X-ray production cross sections (obtained from the theoretical ionization cross sections by the use of theoretical values of fluorescence yields and Coster-Kronig transition probabilities) predicted by the Plane Wave Born Approximation and Perturbed Stationary State theories (including relativistic and Coulomb deflection effects). No one theory provides a best fit to the experimental data. However, there is a marked improvement in the fit as the Z of the target atom increases.

28407 Inner-Shell ionization processes in low Z ($Z \leq 20$) elements by proton bombardment. Olabanji, S.O.; Martinsson, B.G. (Lund Institute of Science and Technology (Sweden)). pp 81-84 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

K-shell X-ray ionization cross section from thin targets of P, S, Cl, K and Ca by proton impact in the energy range of 1.0-5.0 MeV are reported using a Si(Li) detector. Their experimental results are compared with previous very scanty available data and with ECPSSR theory. Data for P are reported for the first time. Results for S, Cl, and K in this wide energy range are also new data. Their results show very good agreement with those of other authors and ECPSSR theory.

28408 L-Shell x-ray production cross sections for 0.5-2.5 MeV Be^+ ions incident upon selected elements from Z = 29 to 47. Price, J.L.; Duggan, J.L.; McDaniel, F.D.; Lapicki, G.; Mehta, R. (North Texas State Univ., Denton (USA)). pp 85-88 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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L-shell X-ray production cross sections are reported for $_4{}^9Be^+$ ions incident upon thin $_{29}Cu$, $_{30}Zn$, $_{32}Ge$, $_{33}Br$, $_{40}Zr$, and $_{47}Ag$ targets. Incident beam energies range from 0.5-2.5 MeV. The results are compared to the predictions of the first Born and ECPSSR theories. The first Born theory overpredicts the data everywhere, especially at high energies, while the ECPSSR theory tends to underpredict the data at low energies and accurately predict the data at high energies. The low energy discrepancy may be due to multiple ionization effects on the fluorescence yields used to convert the total ionization to X-ray production cross sections.

28409 Interplay between nuclear and atomic physics: electron capture in the presence of a nuclear resonance. Baker, O.K.; Stoller, C.; Meyerhof, W.E.; Scheurer, J.N. (Stanford Univ., CA (USA)). pp 89-93 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The total probability, P(E/sub lab/, theta/sub lab/), for electron capture from ^{12}C, ^{14}N, and ^{20}Ne by protons of energy E/sub lab/ between 0.5 and 1.510 MeV and from ^{22}Ne by protons of energy E/sub lab/ between 1.500 and 1.525 MeV has been measured at scattering angles theta/sub lab/ of 30° and 150°. Experimental evidence for the dynamic interference effect between atomic electrons and nuclear reactions is clearly seen in P(E/sub lab/, theta/sub lab/) in the presence of the elastic s-wave nuclear resonance $^{22}Ne(p,p)^{22}Ne$ at 1.510 MeV. The data is compared with theoretical calculations by Amundsen and Jakubassa-Amundsen using the strong-potential Born Approximation.

28410 Cusp and W peak analysis in electron capture to the continuum of bare H and He projectiles from hydrocarbon and fluorocarbon gases. Joyce, J.M.; Bissinger, G. (East Carolina Univ., Greenville, NC (USA)). pp 94-96 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The ECC cusp and W peak shapes for continuum electron capture by ~ MeV/u H^+ and He^{2+} from hydrocarbon and fluorocarbon gas molecules are analyzed with the general parametric expression of Meckbach, Nemirovsky and Garibotti (i) to look for trends in the coefficients of these parameters, (ii) as a way of generating computed cusp shapes to reduce statistical fluctuations in cusp difference spectra, and (iii) to provide information on the deconvoluted $d^2\sigma/d$ nu d theta values for cusp and W peaks in the hydrocarbon gases.

28411 Angular distributions of slow multiply charged ions following capture. Cocke, C.L.; Tunnell, L.N.; Waggoner, W.; Giese, J.P.; Varghese, S.L.; Kamber, E.Y.; Pedersen, J.O.K. (Kansas State Univ., Manhattan (USA)). pp 97-100 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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When slow, multiply charged projectiles capture electrons from neutral targets, the angular distributions of the capturing particles are much more sensitive to the potential curves involved than are the total cross sections. They have constructed an apparatus suitable for measuring angular distributions of these capture products. A position sensitive channel plate chevron followed by a resistive anode is used to determine the scattering angle and a simple retarding grid system is used to select the final charge states. Multiply charged projectiles are obtained from recoil ion sources pumped by fast ion beams from the KSU tandem accelerator. Systems studied include Ne/sup q+/, C/sup q+/ and Ar/sup q+/, with q lying between 3 and 8, on targets of He, D_2 and Ar at accelerating voltages between 40 and 350 V. Selected cases will be presented and discussed.

28412 Electron capture in ion-molecule collisions at intermediate energy. Kimura, M. (Argonne National Lab., IL (USA)). pp 101-105 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract W-31-109-ENG-38.

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Recent progress in theoretical studies on charge transfer in ion-molecule collisions at the intermediate energy is reviewed. Distinction between close and distant collisions is crucial to the understanding of charge transfer processes, as it is in many aspects of ion-atom collisions. For a close collision, explicit representation of the whole collision complex is necessary to describe the collision dynamics correctly, while a model potential approach for the molecule is appropriate for a distant collision. It is shown that these two distinct points of view are necessary for reproducing experimental charge transfer cross sections. Some remarks concerning further theoretical study of ion-molecule collisions are also given.

28413 Evidence for correlated double-electron capture in slow collisions of multicharged ions with He and H_2. Meyer, F.W.; Havener, C.C.; Phaneuf, R.A.; Swenson, J.K.; Shafroth, S.M.; Stolterfoht, N. (Oak Ridge National Lab., TN (USA)). pp 106-110 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84OR21400.

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High resolution measurements of the production of $L_1L_{23}X$ Coster-Kronig and LMX-Auger electrons in slow collisions of C^{4+}, N^{5+}, O^{6+}, and O^{7+} with He and H_2 have been performed, using the method of O^0 Auger spectroscopy. For the latter three projectiles, strong Coster-Kronig lines are observed, which are attributed to the configurations (core)2pnl, produced by double-electron capture. It is argued that production of these nonequivalent electron configurations must involve electron-electron correlation. From a comparison of the production cross sections for these Coster-Kronig electrons and the LMX-Auger electrons, it is further argued that correlation plays a significant role in two-electron transfer processes.

28414 Multiple-Electron capture and ionization in heavy-ion-atom collisions. Mueller, A.; Schuch, B.; Groh, W.; Salzborn, E.; Beyer, H.F.; Mokler, P.H.; Olson, R.E. (Universitaet Giessen (West Germany)). pp 111-114 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Multiple-vacancy production in the rare gas atoms He, Ne, Ar, Kr and Xe by 1.4 MeV/u highly stripped ion impact is studied. From a recoil-ion-projectile-ion coincidence experiment charge-state distributions of target ions were obtained distinguishing between pure ionization and capture of up to three electrons by projectile ions N/sup 6+,7+/, Fe/sup 12+,15+,20+,21+/, Kr^{19+}, Gd^{37+}, and U/sup 30+,36+,41+,44+,48+/. For high-charge-state projectiles the relative fractions of recoil ions for concomitant electron capture and ionization are found to be independent of projectile charge or species.

28415 Electron capture phenomena in proton-atom and proton-molecule collisions. Varghese, S.L. (Univ. of South Alabama, Mobile (USA)). pp 115-118 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Electron capture of protons, in a wide energy range, has been investigated both experimentally and theoretically by many investigators using atomic and molecular targets. Agreement between theory and experiment is very good to excellent, for cases involving atomic targets. They have observed that the additivity principle, that the electron capture cross section from the molecule is the sum of the contributions from the atomic constituents of the molecule, is violated. They have developed a reasonable model to explain the breakdown, which also yielded the atomic capture cross sections. In a very recent work, further support for the molecular dependence of the cross sections have also been provided.

28416 Density matrix of the H (n = 2 and 3) atoms formed in electron capture process of p-He collisions using the AO + model. Jain, A.; Lin, C.D.; Fritsch, W. (Kansas State Univ., Manhattan (USA)). pp 119-121 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The authors have determined full density matrices of H (n = 2 and 3) atoms formed after the electron capture in p-He collisions in the energy range 25-100 keV. An AO + method, in which pseudostates representing excitation and ionization channels are included in the usual two-center atomic-orbital (AO) expansion, is employed. The diagonal elements of the density matrix represent partial cross sections for a given n-manifold; the off-diagonal elements (which give coherences between degenerate states) are used to determine several first order moments (e.g., electric dipole moment) as a function of impact parameter and energy. The integrated (over impact parameter) moments are compared with recent experimental data on the n = 3 shell.

28417 Additivity in electron capture from fluorocarbon gases to the continuum of ~ MeV/u bare H and He projectiles. Gaiser, J.E.; Joyce, J.M.; Mehta, R.; Bissinger, G. (East Carolina Univ., Greenville, NC (USA)). pp 122-123 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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ECC cusp yields obtained from fluorocarbon gas targets of CF_4, C_2F_6 and C_4F_8 at proton energies of 0.6-2.0 MeV and He^{2+} energies of 2.4 and 3.2 MeV exhibit additivity failure similar to that seen from hydrocarbon gases. An intramolecular geometric outscattering model is used to estimate the yield of atomic C and F cusp electrons.

28418 Electron capture studied by a time-of-flight technique. Pedersen, J.O.K.; Cocke, C.L.; Giese, J.P.; Kamber, E.Y.; Waggoner, W.T. (Kansas State Univ., Manhattan (USA)). pp 124-126 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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A time-of-flight spectrometer capable of measuring simultaneously scattering angle and energy of reaction products from collisions between multiply charged ions and neutral targets is described. The apparatus has been used to investigate the collision system Ar/sup q+/ + Ar at an energy of 52.2 q eV. The angular distribution of the reaction products is found to be different for single capture and transfer-ionization.

28419 Electron-capture-to-the-continuum cusp shape variations among a sequence of fluorocarbon gases for ~ MeV/u bare H and He projectiles. Bissinger, G.; Gaiser, J.; Joyce, J.M.; Mehta, R. (East Carolina Univ., Greenville, NC (USA)). pp 127-129 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The ECC cusp shapes for bare H and He projectiles on hydrocarbon (C/sub m/H/sub n/) gas targets show an abrupt, small change when m ≧ 4. Similar shape changes were sought in the ECC cusps obtained with bare H and He projectiles on the fluorocarbon gas series, CF_4, C_2F_6 and C_4F_8. Analyses of these spectra indicate little shape change among the fluorocarbon sequence. The ramifications of this result for the possibility of wakes in molecules will be discussed.

28420 Nuclear resonances and electron capture. Horsdal-Pedersen, E. (Univ. of Aarhus (Denmark)). pp 130-133 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Experimentally determined energy variations of probabilities for electron capture by fast protons scattered through large angles in atomic collisions are presented with special emphasis on the variation near a broad and a narrow nuclear scattering resonance. Half-trajectory electron capture probabilities for fast α-particles formed in the reaction $^{19}F(p, \alpha\gamma)^{16}O$ are also presented and compared with full-trajectory probabilities for accelerated He^{2+} projectiles scattered off O and Ne.

28421 Relativistic distorted wave models for electron capture. Rivarola, R.D.; Deco, G.R. (Instituto de Fisica Rosario (Argentina)). pp 134-138 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Different distorted wave models are studied to describe non-radiative electron capture in relativistic ion-atom collisions. Comparisons are given with other theoretical models and experimental data.

28422 Dynamical image charge effects on convoy electron emission from solid surfaces. Burgdoerfer, J. (Univ. of Tennessee, Knoxville (USA)). pp 139-142 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The authors analyze surface effects on the spectrum of convoy electrons emitted from solids in close association with fast highly charged ions. Three competing mechanisms have been identified: deceleration by the surface barrier, acceleration by the repulsive dynamical image force, and energy loss due to surface plasmon generation. The resulting energy shift is significantly reduced compared to the value for the barrier height for a jellium surface. They also give estimates for the probability for nonadiabatic transitions between bound states due to the sudden perturbation by the potential step upon exit.

28423 Strong convoy electron yield dependence on surface properties. Burkhard, M.; Rothard, H.; Biedermann, C.; Kemmler, J.; Koschar, P.; Groeneveld, K.O. (Institut fuer Kernphysik, Frankfurt (West Germany)). pp 143-146 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Velocity spectra of electrons ejected in the forward direction as a result of ion-solid collisions, are characterized by a cusp shaped structure, the convoy electron peak, if the velocity nu/sub P/ of the projectile matches that of the electron, nu/sub e/ similarly ordered nu/sub p/. Current convoy electron production models assume either volume-multiple step processes or surface-last-layer processes. To probe these models convoy electrons from sputter-cleaned surfaces of C, Al, Ni, Cu, Pd, Ag, Sm, Gd, Au and Bi targets have been studied for the first time under UHV-conditions by proton or krypton ion impact (0.8 and 2.0 MeV respectively), it is found that the convoy electron yield depends strongly on the surface coverage B of adsorbed substances, on the target material and, for Kr^+ ions, on the work function of the investigated elements. For C targets both yield and convoy electron energy are affected by the hydrogen content.

28424 Exit charge state dependence of convoy electron production in heavy-ion-solid collisions. Huelskoetter, H.P.; Burgdoerfer, J.; Sellin, I.A. (Univ. of Tennessee, Knoxville (USA)). pp 147-152 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84OR21400.

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The dependence of the yield of convoy electrons emitted near the forward direction in collisions involving fast ions and thin solid targets on the emergent projectile charge state is presented and described in terms of primary electron loss events in the solid. The data include a large array of projectiles, projectile energies and charge states, as well as targets ranging in thickness from the nonequilibrium well into the equilibrium thickness region. The description presented is consistent with other experimental and theoretical results indicating that the convoy electron production is closely linked to the ELC process observed in binary ion-atom collisions, with the dominant contribution to the convoy yield stemming from excited states of the projectile.

28425 Convoy electron response to the charge pre-equilibrium of ions in solids. Koschar, P.; Clouvas, A.; Heil, O.; Burkhard, M.; Kemmler, J.; Groeneveld, K.O. (J.W. Goethe-Universitaet, Frankfurt (West Germany)). pp 153-158 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Absolute numbers of convoy electrons of H^+ and H^0 (1.2-3.0 MeV) passing through carbon foils ($2 \leqq \text{rho x} \leqq 20$ $\mu g/cm^2$) have been measured using a calibrated magnetic 90°-sector electron analyzer. In the charge pre-equilibrium (rho x $\leqq$ 5 $\mu g/cm^2$) the convoy electron yield is strongly dependent on the initial charge state and is dominated by the direct loss of the projectile electron (DELC) in case of initial charge state 0. Qualitatively and quantitatively the experimental data can be described by a two-step model which includes the production of convoy electrons as a function of charge changing and excitation processes (referred to as direct and indirect ELC and direct and indirect ECC) and the projectile independent transport of convoy electrons through the solid.

28426 L-MM Auger electron production in 0.3-1.6 MeV Kr-Kr collisions. deGroot, P.; Zarcone, M.J.; Kessel, Q.C. (Univ. of Connecticut, Storrs (USA)). pp 159-161 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Relative total cross sections for Kr L-Auger electron emission are presented and compared with the corresponding X-ray data of Woerlee and Shanker and coworkers. These data sets all show the same incident ion energy dependence, indicating a constant fluorescence yield for the collision conditions under consideration. These data are also in agreement with a rotational coupling calculation by Shanker and coworkers that was carried out within the framework of the one-electron molecular orbital model of Fano and Lichten.

28427 He^+-induced Auger electron studies in carbon-containing molecules. Ariyasinghe, W.M.; McElroy R.D. Jr.; Powers, D. (Baylor Univ., Waco, TX (USA)). pp 162-167 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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He^+-induced KLL Auger electron spectra of energy resolution 0.3 and 0.6 eV have been measured for incident energies of 0.45 to 2.1 MeV for several simple carbon-containing compounds (CH_4, C_2H_6), C_2H_4, C_2H_2, CO, CO_2, CF_4, and C_2F_6). The results indicated that line widths and energies of major lines in the hydrocarbons and in CO induced by He^+ bombardment do not appear to be different from those produced by e^- bombardment. Differences of more than 30% are observed in the measured relative He^+-induced Auger yields, and they attempt to reproduce the observed variations in yield by scaling first to an effective carbon valence number and second with the use of electron scattering cross sections. Results of a preliminary analysis of the Auger line structure are reported.

28428 Surgery of fast, highly charged ions studied by zero-degree Auger spectroscopy. Stolterfoht, N.; Miller, P.D.; Krause, H.F.; Yamazaki, Y.; Swenson, J.K.; Bruch, R.; Dittner, P.F.; Pepmiller, P.L.; Datz, S. (Oak Ridge National Lab., TN (USA)). pp 168-172 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84OR21400.

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Zero-degree Auger spectra were measured for the projectile in collisions of oxygen and carbon on He with incident charge state of q = 2-5 and for energies for 5 to 30 MeV. Since the light target particle He acts selectively on the projectile ion, they refer to the present method as ion surgery. Apart from the one-electron processes of single excitation and single loss, two-electron processes such as transfer excitation and transfer loss are studied.

28429 High Rydberg and Auger states in fast ion-atom collisions: zero-degree observations. Schneider, D.; Stolterfoht, N.; Schiwietz, G.; Schneider, T.; Zeitz, W.; Bruch, R.; Chung, K.T. (Hahn-Meitner-Institut Berlin (West Germany)). pp 173-179 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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High resolution measurements of autoionization and Auger electrons emitted from projectile ions have been performed using the method of 0° electron spectroscopy. The results clearly demonstrated the potential of the method for an investigation of specific excitation mechanisms with selectively excited beam ions. It is further shown that the experimental arrangement allows also to investigate effects of external electric fields on high Rydberg states (n > 100) as they are formed in fast foil or gas excited projectiles.

28430 Carbon K-shell x-ray and Auger-electron cross sections and fluorescence yields in benzene bombarded by 0.6 to 2.0 MeV protons. Bhalla, R.P.; McDaniel, F.D.; Lapicki, G. (North Texas State Univ., Denton (USA)). pp 180-183 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Carbon K-shell X-ray and Auger-electron cross sections were measured by 0.6-2.0 MeV proton bombardment of C_6H_6. The ionization cross sections are compared to the first Born and perturbed stationary state theories, and are in agreement with both within experimental uncertainties. The fluorescence yield, evaluated as a ratio of the X-ray to the ionization cross section, shows a slight decrease with the decreasing proton energy which is attributed to multiple ionization effects.

28431 High resolution electron spectroscopy at nonzero degree observation angles. Swenson, J.K.; Anthony, J.M.; Reed, M.; Benhenni, M.; Shafroth, S.M.; Peterson, D.M.; Hendrik, L.D. (Univ. of North Carolina, Chapel Hill (USA)). pp 184-188 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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An electron spectrometer has been developed for the study of Auger electrons ejected from fast (MeV) ion beams at nonzero degree observation angles in high resolution. The analyzer is a double pass 30° parallel plate analyzer equipped with a chevron microchannel plate detector with resistive anode readout for position sensitive detection of electrons in the focal plane. High resolution is obtained through second order focusing of projectile electrons at an observation angle of 9.6° and through deceleration of these electrons before energy analysis. Spectra have been acquired for O/sup q+/ + H_2, He and Ne (q = 3, 4 and 6) for ion energies ranging from 6 to 22 MeV. Various processes such as excitation, ionization, capture, capture plus ionization, and capture plus excitation are identified for different incident charge states. Performance of the spectrometer is discussed along with its capabilities and limitations.

28432 Molecular effects observed in Auger transitions from H^+ and H_2^+ collisions with solid, molecular and atomic targets. Burkhard, M.; Koschar, P.; Heil, O.; Kemmler, J.; Koever, A.; Szabo, G.; Berenyi, D.; Groeneveld, K.O. (J.W. Goethe Universitaet, Frankfurt (West Germany)). pp 189-192 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The molecular effect is measured by the ratio R = Y/sub A/(H_2^+)/Y/sub A/(H^+) of H_2^+- and (1 MeV/u) H^+-induced Auger electron yields. For carbon foil surfaces R/sub solid/ ≦ 1.3 resulting from the high energy region of the Auger peak is caused mostly by the projectile electron interacting with the target atoms. In collisions with CH_4, C_4H_{10} and Ar targets, R/sub gas/ ≦ 01.75 is attributed to screening effects under single collision conditions. The Auger line shapes and R values resulting from solid and gaseous targets are discussed.

28433 Inelastic scattering of 120 keV electrons from carbon, aluminum, vanadium and silver foils. Salehkoutahi, S.; Quarles, C.A. (Texas Christian Univ., Fort Worth (USA)). pp 193-195 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The inelastic scattering of 120 keV electrons from thin-film targets of carbon, aluminum, vanadium, and silver has been measured at 120° and 135°. The number of inelastically scattered electrons at each angle has been normalized to the elastically scattered electrons and the difference of the spectra at the two angles has been computed to correct for backscattering in the Si detector. The results are compared with a double scattering process of ionization followed by elastic scattering in the target. Significantly more backscattering is observed than can be explained by either the single scattering processes of ionization or bremsstrahlung or by the double process considered. Additional double processes need to be considered to resolve the discrepancy.

28434 Total cross sections for ionization of the K-shell by electron bombardment. Westbrook, G.L.; Quarles, C.A. (Texas Christian Univ., Fort Worth (USA)). pp 196-198 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Measurements have been made of the total cross section for ionization of the K shell by bombarding thin foil targets with 100 keV electrons from an electrostatic accelerator. The atomic number of the targets ranged from 13 to 79. The cross sections were determined by normalization to the theoretical atomic-field bremsstrahlung cross sections. Two solid state detectors were used in this measurement: a high purity germanium detector and a lithium drifted silicon detector. Results from both detectors will be compared for some targets. The Z dependence of the cross section will also be compared with theoretical calculations.

28435 Low energy charge exchange of multicharged ions: a new spectroscopy. Bliman, S.L.; Bonnet, J.J.; Cornille, M.; Druetta, M.; Hitz, D.; Mayo, M. (CNRS/CENG, Grenoble (France)). pp 199-204 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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A series of experimental studies of one-electron capture from He and H_2 by various highly charged low energy ions have been performed. The observation of the radiative decay from the capture level(s) shows: the capture level can be predicted and is shown to depend on ion charge and target ionization potential; when projectile energy levels are known full reconstruction of the capture cross section is possible; fundamental spectroscopic studies are performed in a situation where a single charge state of an identified ion radiates; and the spectroscopic observation of doubly excited states is possible.

28436 Single and double charge exchange processes with low energy multicharged ions. Vernhet, D.; Chetioui, A.; Wohrer, K.; Politis, M.F.; Touati, A.; Rozet, J.P.; Bouisset, P.; Stephan, C. (Universite P. et M. Curie, Paris (France)). pp 205-208 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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An original method is presented for extracting information on single and double capture processes in low velocity collisions with bare and one-electron projectiles. Experimental data are reported for P(l) distributions in single capture and for the percentage of double capture with respect to the single capture in 10 q keV $Ne^{9+} \rightarrow H_2$ and $Al^{13+} \rightarrow He$ systems (nu ~ 0.4 a.u.). The preferential n state populated by double capture (after autoionization) is also deduced.

28437 Recent studies of simultaneous ionization and charge transfer in helium ion-atom collisions. DuBois, R.D. (Pacific Northwest Lab., Richland, WA (USA)). pp 209-213 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC06-76RL01830.

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In their laboratory, they are interested in ionization of atomic and molecular targets induced by light ion impact. Generally these collisions are studied by monitoring the ejected electron spectra with the assumption that each ionizing event leads to a single secondary electron. By measuring the target ionization charge states produced by directly ionizing and charge changing collisions, they have obtained cross sections for direct ionization, pure charge transfer, and charge transfer plus ionization thus making it possible to distinguish how target ionization occurs. It was found that charge transfer plus ionization can sometimes be more probable than pure charge transfer alone. This is important because one mechanism which has until recently been disregarded as a means of producing free electrons is the possibility of capturing an electron from the target and simultaneously ionizing one or more target electrons. For ion impact velocities comparable to, or less than, the outer shell bound electron velocities, they have found that charge transfer plus ionization can be a substantial, if not principal, means of producing free electrons.

28438 Measured multipole moments of continuum electron transfer angular distributions. Elston, S.B. (Univ. of Tennessee, Knoxville (USA)). pp 214-218 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The velocity space distribution of electrons emitted near the forward direction from collisions involving fast, highly stripped oxygen ions with gaseous and solid targets is presented and described in terms of multipole moments of the ejected charge distribution, which permits direct comparison with recent theory. The measurements are produced by employing position-sensitive electron detection to combine emission angle definition with conventional electrostatic spectrometry. Agreement obtained between theory and distributions observed for binary continuum electron loss processes coupled with a similar multipole content observed with solid targets suggests a model of convoy electron production dominated by electron loss from the projectile within the bulk of the target. Further, the connection between multipoles of the projectile electron emission distribution in single collisions and the state of excitation of that projectile excited system may provide the basis for a probe of the state of ions traversing bulk solid matter.

28439 Ionization and charge transfer in high-energy ion-atom collisions. Schlachter, A.S.; Berkner, K.H.; Stearns, J.W.; Graham, W.G.; Bernstein, E.M.; Clark, M.W.; Tanis, J.A.; Schmidt-Boecking, H.; Kelbch, S.; Ullrich, J.; Hagmann, S. (Lawrence Berkeley Lab., CA (USA)). pp 219-223 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC03-76SF00098.

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Electron capture and loss by fast highly charged ions in a gas target, and ionization of the target by passage of the fast projectile beam, are fundamental processes in atomic physics. These processes, along with excitation, can be experimentally studied separately (singles) or together (coincidence). This paper is a review of recent results on singles measurements for electron capture and loss and for target ionization, for velocities which are generally high relative to the active electron, including recent ionization measurements for a nearly relativistic projectile.

28440 Determination of density matrices of H(n=3) atoms formed in charge transfer between protons and helium atoms. Westerveld, W.B.; Ashburn, J.R.; Cline, R.A.; Stone, C.D.; Van Der Burgt, P.J.M.; Risley, J.S. (North Carolina State Univ., Raleigh (USA)). pp 224-227 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Fast hydrogen atoms are formed in charge transfer reactions between incident protons (60 keV) and helium atoms. The formed excited hydrogen atoms are allowed to decay in the presence of externally applied electric fields which dramatically change the intensity and polarization of the emitted radiation. Balmer-alpha radiation emitted from a 7 mm long section of the proton beam is measured as a function of applied electric field strength using a precision polarimeter. Detailed analysis of the experiment in which the time evolution of the hydrogen atoms in the presence of external fields is calculated allows the extraction of the full, axially symmetric density matrix of the H(n=3) atoms at the time of their production.

28441 Charge-exchanging cross sections in collisions of fast hydrogen species with light noble gases. Almeida, D.P.; De Castro Faria, N.V.; Freire, F.L. Jr.; Montenegro, E.C.; De Pinho, A.G. (Universidade Catolica, Rio de Janeiro (Brazil)). pp 228-231 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Cross sections for single- and double-electron capture and loss for hydrogen species in collisions with He, Ne and Ar atoms have been determined. Pure beams of H^+ (D^+), H^0 and H^- obtained from a 4MV Van de Graaff accelerator were passed through a differentially pumped gas cell. The three resulting charge states were magnetically separated and simultaneously recorded. The cross sections were obtained from the normalized growth curves as a function of the target thickness.

28442 K- and L-shell resonant transfer and excitation i ion-atom collisions. Bernstein, E.M.; Clark, M.W.; Tanis, J.A.; Graham, W.G.; McFarland, R.H.; Morgan, T.J.; Mowat, J.R.; Mueller, D.W.; Stockli, M.P.; Berkner, K.H.; McDonald, R.J. (Western Michigan Univ., Kalamazoo (USA)). pp 232-236 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Recent experimental studies of resonant transfer and excitation (RTE) in ion-atom collisions are reviewed. In the RTE process correlated electron capture and projectile excitation occur together in a single encounter with a target atom. Measurements of Ca/sup q+/ + H_2 (q = 10-19) from 100 to 3760 MeV establish the projectile charge-state dependence of K-shell RTE and provide a detailed test of the theory. Structure due to RTE is observed in the energy dependence of the total electron-capture cross sections for this collision system. A comparison of the Ca^{17+} + H_2 data with previous results for Ca^{17+} + He demonstrates the effect of the target-electron momentum distribution on the RTE process. Studies of 230-610 MeV Nb^{31+} + H_2 provide information about RTE involving projectile L-shell excitation. All the measurements are in reasonable agreement with theoretical calculations.

28443 Coupled state calculations of vacancy transfer probabilities from 2p and 3d rotational coupling in Ar-Mg collisions. Xiong, Y.; Cipolla, S.J. (Creighton Univ., Omaha, NE (USA)). pp 237-239 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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For heavy ion-atom collisions at low energies, rotational coupling of the $2p\pi$-$2p\sigma$ molecular orbitals is known to be responsible for K-vacancy production in the lighter collision partner, while $3d\delta$-$3d\pi$-$3d\sigma$ rotational coupling is responsible for L-vacancy production in both collision partners. They use the screened classical-path impact parameter formalism to set up and solve the coupled-state equations for the vacancy transfer probability amplitudes in these two cases.

28444 Application of distorted wave models for electron emission in ion-atom collisions. Rivarola, R.D.; Fainstein, P.D. (Instituto de Fisica Rosario (Argentina)). pp 240-242 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The continuum distorted wave-eikonal initial state model is applied to calculate double differential cross sections for electron emission produced by proton impact on H and He targets. Comparisons are given with symmetric eikonal and first order-Born calculations and with experimental data.

28445 Ultimate sharpness of the ECC cusp. McGuire, J.H.; Reeves, T.; Deb, N.C.; Sil, N.C. (Kansas State Univ., Manhattan (USA)). pp 243-244 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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In electron capture to the continuum (ECC) the distribution of scattered electrons is sharply peaked when the velocity of the electron nu/sub e/ matches the velocity of the projectile nu/sub p/. The authors discuss the significance of this cusp and present a closed form expression for this cusp in the fully peaked strong potential Born approximation (SPB-FP). This cusp diverges at nu/sub e/ = nu/sub p/ for scattering with unscreened Coulomb potentials. In reality this divergence is removed by various effects, including screening of Coulomb potentials in atomic collisions.

28446 Ejected electron energy distributions for double ionization via direct and rearrangement mechanisms. McGuire, J.H.; Heil, T.G. (Kansas State Univ., Manhattan (USA)). pp 245-247 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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For multiple ionization of atomic systems by fast projectiles two simple mechanisms may contribute: direct ionization in which each electron is removed by colliding directly with the projectile; and final state rearrangement (e.g., shakeoff) in which the second electron leaves as the target relaxes after the first ionizing event in the simplest picture the two electrons are uncorrelated. This uncorrelated picture may apply when the first electron leaves quickly. The authors calculate and compare ejected electron energy distributions in the simple uncorrelated picture for electrons produced by both direct rearrangement mechanisms following direct ionization of a first electron.

28447 New features of secondary electron spectra in ion-atom collisions. Macek, J. (Univ. of Nebraska, NE (USA)). pp 248-251 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Secondary electron spectra produced by ion-atom collisions typically show three prominent features; (a) a peak in the velocity distribution at zero velocity, (b) a peak when the electron velocity matches the ion velocity, and (c) a peak at electron energies and angles corresponding to conservation of energy and momentum in a binary encounter of the projectile and the initially bound electron. A fourth structure, namely a sharp ridge in the secondary distribution concentrated at zero transverse electron velocity has been recently identified. Data showing this new feature and its interpretation is reviewed.

28448 Inner-Shell physics: application to K-shell ionization. Land, D.J. (Naval Surface Weapons Center, Silver Springs, MD (USA)). pp 252-255 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The direct-Coulomb, inner-shell ionization process of heavy target atoms by light ions (p, He, Li) is usually explained through the introduction of several physical phenomena into lowest-order perturbation theory. The present paper considers a detailed investigation of one of these effects, the increase in the inner-shell electron binding energy caused by the presence of the positively charged projectile. New calculations for the total K-shell ionization cross section are performed in which the K-shell electron binding energy is evaluated as a function of the projectile position along a hyperbolic Coulomb trajectory. Numerical results are presented for ^{3}He ions incident on Ti in the energy range 0.2-1.6 MeV/u. The results of these calculations might lead to the question of whether the binding effect is completely understood in the context of inner-shell ionization.

28449 Calculations of coincident ionization plus excitation. Becker, R.L. (Oak Ridge National Lab., TN (USA)). pp 256-260 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84OR21400.

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For Li- and Be-like ions, K X-ray yields, together with detection that the ionic charge has increased, give the cross section

for ionization plus excitation (IE), a process which can exhibit electron-electron correlations. Measurements of IE for $^{14}Si^{11+}$ + He stimulated their coupled-channels calculations in the independent-Fermi-particle model (IFPM), which includes Pauli correlations. The authors discuss how the IFPM expressions, generalized here to include an open shell, differ from those for distinguishable electrons. The sensitivity of σ/sub IE/ to correlations is shown. Recent additional measurements and future ones giving excitation functions for resolved configurations and complementary Auger data will provide even more sensitive tests of collisional correlation theory.

28450 **Molecular description of two-electron atoms.** Feagin, J.M. (California State Univ., Fullerton (USA)). pp 261-265 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract FG03-86ER13521.

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It is shown how potential curves can be obtained for two-electron states of atoms by scaling calculations on the H_3^+ molecular ions. For doubly excited states the curves show a strong similarity to adiabatic hyperspherical potential curves and thus explain certain features in hyperspherical calculations in terms of molecular symmetries. The connection with the Wannier description of near-threshold excitation is also considered.

28451 **Calculations of atomic parameters of dielectronic satellite lines of Ca XX resonance lines.** Karim, K.R.; Bhalla, C.P. (Kansas State Univ., Manhattan (USA)). pp 266-269 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Theoretical atomic parameters calculated with the multiconfiguration Thomas-Fermi model were recently reported and used in the analysis of dielectronic satellite spectra of hydrogen-like calcium observed from the P78 solar flare. A comparison of their calculations based on the Hartree-Fock-Slater atomic model shows a reasonable agreement for n = 2 satellites but systematic and sometimes significant differences are found for n = 3 and 4 satellites. Here they present atomic parameters for dielectronic satellite lines of Ca XX resonance lines. Effects of radiative cascades on the intensities of the satellite lines that proceed via lower typing autoionizing states are also investigated.

28452 **Z-Dependence of the intensity ratio of J-line to hydrogen-like resonance line in high temperature low density plasmas.** Bhalla, C.P.; Karim, K.R. (Kansas State Univ., Manhattan (USA)). pp 270-272 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Theoretical transition rates and energies are calculated with the Hartree-Fock-Slater atomic model for double excited helium-like states. The configuration interaction in the sample complex and the spin-orbit coupling effects are included for n = 2, 3 and 4 satellites. The atomic numbers considered are 10, 14, 18, 20, 24 and 26. Using the 1s-2p excitation rate coefficients for a hydrogen-like ion and their theoretical results, the intensity ratio of the J-line ($1s2p^1P_1$-$p^{21}D_2$) to the Lyman-α_1 line are calculated and are presented here.

28453 **Brief survey of theoretical explanations of anomalous positron peaks.** Balantekin, A.B. (Univ. of Wisconsin, Madison (USA)). pp 273-275 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Recent measurements of coincident electrons and positrons yielding a multiple peak structure, coupled with the observation of similar peaks in positron-heavy-ion collisions suggest a different explanation than the spontaneous decay of vacuum in the strong electric field. In this article, first the experimental situation is reviewed, then a brief survey of theoretical explanations is presented.

28454 **Strong-Coupling effects in charge transfer and l change observed in intermediate-velocity collisions of ions on Rydberg-atom targets.** MacAdam, K.B.; Rolfes, R.G.; Sun, X.; Smith, D.B. (Univ. of Kentucky, Lexington (USA)). pp 280-283 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Two strong-coupling effects are described in collisions of singly charged ions with laser-excited Na Rydberg atoms. For projectile velocities comparable with orbital velocities in the target a multitude of nearly degenerate Rydberg states become coupled during the encounter. Evidence is given for a breakdown of the classical n^4 scaling rule in charge transfer, based on a factor-of-four difference between H(1s) and scaled Rydberg data for slow collisions. Dipole-forbidden l change in Na(28d) + Na^+ collisions occurs below the matching velocity despite impact parameters large enough that the dipole approximation for the perturbing potential remains valid.

28455 **Simple formula for the energies of doubly excited states.** Lin, C.D.; Watanabe, S. (Argonne National Lab., IL (USA)). pp 284-287 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract W-31-109-ENG-38.

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A simple formula for the energy levels of double excited states of atoms and multiply charged ions is derived and expressed in terms of a set of new correlation quantum numbers. The accuracy of the formula is checked by comparing with the results from other elaborate calculations. Modification of the formula for doubly excited states of multielectron atoms are also presented.

28456 **Experimental apparatus for studying double differential scattering by low energy x/sup q+/ ions from He.** Kamber, E.Y.; Cocke, C.L.; Giese, J.P.; Pedersen, J.O.K.; Waggoner, W.; Varghese, S.L. (Kansas State Univ., Manhattan (USA)). pp 288-290 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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A new differential energy gain spectrometer has been constructed and tested for the study of the double differential cross section, in energy and angle, for state selective electron capture processes of low energy multiply-charged ions with atomic gases. Translational energy spectra for single electron capture by N^{2+} and O^{2+} colliding with He has been measured in the impact energy range 60-200 eV and scattering angles between 0° and 4°. In these collision systems, the dominant processes observed are due to capture into the ground state ($2p^2\ ^3P$) of N^+ and the metastable state ($2p^3\ ^2P$) of O^+, respectively.

28457 **Models for production of optical polarization in beam-foil interaction.** Schroeder, H.; Gabriel, H. (Freie Universitaet Berlin (West Germany)). pp 291-295 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The authors briefly review the following beam-foil interaction mechanisms for the production of optical polarization: (a) effect of the loss process of the excited projectile electron on the formation depth of the final state, (b) effect of the surface electric field, (c) capture of a target electron into an excited projectile state, and (d) Coulomb excitation of a projectile electron by the ionic cores of the target. Estimates of their relative importance are given.

28458 Beam-Foil spectroscopy in the EUV employing a position sensitive microchannel plate. Demarest, J.A.; Watson, R.L. (Texas A & M Univ. (USA)). pp 296-300 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A 50 mm long microchannel plate was adapted to a 1-m grazing incidence spectrometer equipped with a 1200 1/mm grating and applied to the measurement of beam-foil spectra of highly ionized neon in the EUV. A wavelength resolution of better than 1.0 A was achieved using a 100 μm entrance slit for spectra that sampled a wavelength region spanning approximately 100 A. The overall counting efficiency of the spectrometer system operating in a multichannel analysis mode improved by two orders of magnitude relative to that obtained by a single channel scan mode analysis. Wavelength accuracies on the order of 0.1 A were achieved.

28459 Beam foil spectroscopy of n = 3 to n = 2 transitions in highly stripped heavy ions. Dietrich, D.D.; Chandler, G.A.; Egan, P.O.; Ziock, K.P.; Mokler, P.H.; Reusch, S.; Hoffman, D.H.H. (Lawrence Livermore National Lab., CA (USA)). pp 301-304 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract W-7405-ENG-48.

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The spectroscopy of very highly ionized atoms provides an important testing ground for multielectron atomic theory. The authors report preliminary experimental results on the $n = 3 \rightarrow 2$ spectra of Bi^{73+} and Au^{69+} obtained at the GSI UNILAC accelerator.

28460 Measurements of helium excitation in Be^+-He and Mg^+-He collisions. Redd, E.; Gay, T.J.; Blankenship, D.M.; Park, J.T.; Peacher, J.L.; Seely, D.G. (Univ. of Missouri, Rolla (USA)). pp 305-308 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The authors have observed level specific excitation of He(n = 2,3) in collisions of Be^+ and Mg^+ with He at projectile velocities of 1/2 a.u. With both Be^+ and Mg^+ projectiles, excitation for small scattering angles (large impact parameters) is appreciable, indicating the occurrence of direct excitation. Angular differential excitation cross sections were measured with Mg^+ projectiles at c.m. angles up to 9.6 mrad (11.7 keV deg). Molecular excitation begins to dominate these cross sections at about 1.8 keV deg or b = 1.5 a.u. The total He(n=2) excitation cross section if $(6.86 \pm 0.38) \times 10^{-18}$ cm^2 at this velocity, as compared with a Mg^+ (3s → 3p) cross section of $(8.49 \pm 2.09) \times 10^{-18}$ cm^2.

28461 Radiative lifetimes for some 5p levels of Kr^+. LeMond, J.E.; Head, C.E. (Univ. of New Orleans, LA (USA)). pp 309-311 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Using a Kr^+ ion beam from a small positive-ion accelerator, the authors have measured the radiative lifetimes of six 5p levels of Kr^+ by means of the time-of-flight technique. These levels along with their measured lifetimes and estimated uncertainties in nanoseconds are: 5p ^{4}P/sub 5/2/, 7.7 +/- 0.6; 5p ^{4}D/sub 3/2/, 7.96 +/- 0.37; 5p ^{4}D/sub 5/2/, 9.48 +/- 0.50; 5p ^{4}D/sub 7/2/, 8.00 +/- 0.51; 5p'^{2}F/sub 5/2/, 8.96 +/- 0.40; 5p'^{2}F/sub 7/2, 8.31 +/- 0.39. The uncertainties are sums of the computed statistical errors and estimated maximum systematic errors in beam velocity and position.

28462 Orientation arising from grazing collisions of argon ions with a copper target. Lenoir, J.; Liu, J.; Church, D.A. (Texas A & M Univ., College Station (USA)). pp 312-315 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The orientation of S, P, D, and F states of 20-100 keV argon ions by grazing collision with a polished copper target was studied. A general increase in the relative circular polarization of the emitted light with ion velocity was found, with larger magnitudes of circular polarization for D and F states than for S and P states. Alignment tensor parameters were found to be significant in the interpretation of the orientation data.

28463 Angular distributions of very low energy recoil ions. Gonzalez Lepera, C.E.; Breinig, M.; Burgdoerfer, J.; DeSerio, R.; Elston, S.B.; Gibbons, J.P.; Huelskoetter, H.P.; Liljeby, L.; Short, R.T.; Vane, C.R. (Univ. of Tennessee, Knoxville (USA)). pp 316-320 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The authors present the first measurements of the angular distribution of recoil ions near 90° with respect to the incident projectile direction. Beams of 22.5 and 33 MeV chlorine ions (incident charge states q = 4,5,8) have been used as hammer beams incident on Ne atoms. They do not confirm the long standing assumption that these recoil ions are ejected preferentially at angles very near 90° with respect to the primary beam direction, although they do have energies typically less than 5 eV. Recoil ions ejected around 90° have an energy distribution appreciably wider than those ejected at either larger or smaller angles.

28464 Molecular structure studies by 3D imaging of fast ion beams. Kanter, E.P.; Vager, Z.; Both, G.; Cooney, P.J.; Faibis, A.; Koenig, W.; Zabransky, B.J.; Zajfman, D. (Argonne National Lab., IL (USA)). pp 321-324 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract W-31-109-ENG-38.

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The use of the Coulomb explosion technique combined with a radically new multiparticle detector, extremely thin film targets, and low-excitation ion source has enabled, for the first time, direct measurements of the complete stereostructure of complex polyatomic molecular ions. They outline the methods used and present results for protonated acetylene ($C_2H_3^+$) and the methane cation (CH_4^+) as examples. They demonstrate the techniques by which these methods can be generalized to determine directly vibrational motions in polyatomic molecules.

28465 Autodetachment spectroscopy of metastable negative ions. Kvale, T.J.; Alton, G.D.; Compton, R.N.; Thompson, J.S.; Pegg, D.J. (Oak Ridge National Lab., TN (USA)). pp 325-328 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract FG05-85ER13456;AC05-84OR21400.

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This paper is a review of some of their recent measurements on the metastable negative ions, Be^- and He^{-*}. Fast-beam autodetachment spectroscopy was used to determine the electronic states of atomic and molecular ions.

28466 Highly-charged ions at electron-volt energies and below: production, storage, and measurements. Church, D.A. (Texas A & M Univ., College Station (USA)). pp 329-334 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Goals of thermal multicharged ions for collision and spectroscopic studies, and of subthermal antiprotons for gravitational tests and atomic and nuclear measurements, lead to requirements of capture, confinement, and cooling of these charges. Storage of recoil ions in a radio-frequency trap, synchrotron radiation production of stored multicharged ions near room temperature, and external injection of ions into a Penning trap are discussed, and used as a basis for speculations on achieving higher charge states, lower energies, and neutral antimatter.

28467 Recent measurements of coherent transition radiation. Moran, M.J. (Lawrence Livermore National Lab., CA (USA)). pp 335-338 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract W-7405-ENG-48.

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An extended series of experiments has been used to investigate transition radiation in the X-ray spectral region. The X-rays were generated at the Lawrence Livermore National Laboratory electron-positron linear accelerator by 54 MeV electrons traversing multiple thin-foil targets. The measured angular and spectral distributions have shown excellent agreement with calculated predictions based on a simplified theoretical description of transition radiation. Recently, energy-resolved measurements of X-ray generation by targets consisting of multiple closely-spaced foils has clearly demonstrated the longitudinal coherence of transition radiation. This behavior might lead to a variety of applications such as tuneable narrow-band X-ray sources, measurement of X-ray dielectric constants, or particle beam diagnostics. These issues will be discussed and recent results will be presented.

28468 Experimental CO_2 evolution curve obtained during 250 keV D^+ implantation on mylar and its theoretical model. Chaturvedi, U.K.; Menon, V.J.; Pathak, R.; Nigam, A.K. (Banaras Hindu Univ., Varanasi (India)). pp 353-357 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The partial pressure variation curve of the evolved CO_2 during implantation of 250 keV D^+ ion beam in Mylar has been experimentally measured and theoretically explained on the basis of a diffusion based model. Unlike the earlier percolation model, their model explains the rising portion of the curve (i.e. the pre-maximum portion) very satisfactorily. This pre-maximum portion is very important as most of the radiolytic processes take place during this short span, due to the high rate of energy deposition by the ion beam. The reasons for the failure of the percolation model in the pre-maximum portion are also explained.

28469 Secondary electron emission from carbon foils resulting from fast ion bombardment. Dednam, C.C.; Froneman, S.; Mingay, D.W.; Van Waart, J. (Atomic Energy Corp. of South Africa, Pretoria). pp 366-368 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The forward, backward and total secondary electron yields from thin carbon foils traversed by heavy ions (H, He, B, C, O and F) have been measured as a function of beam energy (0.4-3.7 MeV). These values have been shown to be dependent on the beam density, the incoming charge state and the extent of hydrogen contamination of the foil surfaces. The yields measured have been related to the stopping powers for the respective projectiles and an enhancement in the value of $\gamma/(dE/dx)$ has been observed for ion velocities of $\leqq 6 \times 10^8$ cm/s.

28470 Signal enhancement in electron-ion crossed-beams experiments. Mueller, A.; Hofmann, G.; Tinschert, K.; Sauer, R.; Salzborn, E.; Becker, R. (Justus-Liebig-Universitaet Giessen (West Germany)). pp 369-372 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The collision rate in colliding-beams experiments increases with the particle density in the interaction region. High-density electron beams have been used in measurements of electron-impact ionization of ions for which ratios of signal to noise of more than 100:1 have been obtained. However, space-charge potentials in the high-intensity electron beam may affect the ion beam and the electron energy distribution. The authors have investigated these influences and demonstrated that space charge compensation of the electron beam by slow positive ions is a feasible method for accurate cross section measurements.

28471 Atomic data for highly charged ions. Applications to x-ray laser design and thermonuclear fusion. Younger, S.M. (Lawrence Livermore National Lab., CA (USA)). pp 373-376 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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A detailed understanding of a myriad of atomic processes is proving important for the development of short wavelength lasers and to the achievement of controlled thermonuclear fusion. A brief overview of some X-ray laser design issues is presented along with a discussion of relevant atomic data needs. Special attention is given to the need for experimental verification of rate coefficient data which are important for determining laser kinetics. Approaches to magnetic and inertial confinement fusion are reviewed with emphasis on atomic processes affecting both fuel burn and plasma diagnostics. Recent advances in the development of high power ICF drivers, both lasers and particle beams, are shown to suggest new areas of research involving very highly charged ions in dense hot plasmas.

28472 Atomic charge exchange and fusion diagnostics. Bransden, B.H. (Univ. of Durham (England)). pp 377-380 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Electrons captured by positive ions from neutral atoms preferentially populate excited states, which can be detected by the subsequent radiation. This circumstance can be used in plasma diagnostics to measure the concentration of impurity ions, provided the charge exchange cross sections into specific final states are known. The reliability of theoretical cross sections based on expansion models for such reactions is assessed and some new results are presented for the reactions $Be^{2+} + H^+ \rightleftharpoons Be^+ + H^+$.

28473 **Atomic physics and synchrotron radiation: the production and accumulation of highly charged ions.** Johnson, B.M.; Meron, M.; Agagu, A.; Jones, K.W. (Brookhaven National Lab., Upton, NY (USA)). pp 391-396 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC02-76CH00016.

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Synchrotron radiation can be used to produce highly-charged ions, and to study photoexcitation and photoionization for ions of virtually any element in the periodic table. To date, with few exceptions, atomic physics studies have been limited to rare gases and a few metal vapors, and to photoexcitation energies in the VUV region of the electromagnetic spectrum. These limitations can now be overcome using photons produced by high-brightness synchrotron storage rings, such as the X-ray ring at the National Synchrotron Light Source (NSLS) at Brookhaven. Furthermore, calculations indicate that irradiation of an ion trap with an intense energetic photon beam will result in a viable source of highly charged ions that can be given the name PHOBIS: the photon beam ion source. Promising results, which encourage the wider systematic use of synchrotron radiation in atomic physics research, have been obtained in recent experiments on VUV photoemission and the production and storage of multiply-charged ions. An overview of the field, current plants, and future possibilities will be presented.

28474 **High resolution synchrotron excited soft x-ray core level spectroscopy at NSLS.** Morar, J.F. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY (USA)). pp 410-413 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Examples of soft X-ray core level excitations studies are presented which span a range from excitons of the diamond C 1s level and intermediate products of the silicon fluorine etching reaction to the interface structure of CaF_2 grown epitaxially on silicon (111) surfaces. Two attributes of synchrotron radiation sources have been crucial in all of the examples presented: tunability over a broad photon energy range, and high instrument resolution at a useable intensity.

28475 **Synchrotron radiation inner-shell photoionization of atomic and molecular gases.** Short, R.T.; O, C.S.; Levin, J.C.; Sellin, I.A.; Johnson, B.M.; Meron, M.; Jones, K.W.; Church, D.A. (Univ. of Tennessee, Knoxville (USA)). pp 417-419 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84OR21400.

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A time-of-flight (TOF) spectrometer has been used to measure the average kinetic energies of near-thermal atomic and molecular ions, as well as energetic molecular ion fragments, produced by inner-shell photoionization of atomic and molecular gas targets using X-ray from the National Synchrotron Light Source (NSLS). While atomic and molecular ions acquire very little energy from the initial photoionization event and subsequent vacancy cascades, multiply-charged molecular ions decompose rapidly, producing fragment ions which have kinetic energies determined by their configuration at the moment of decomposition. The strong effects observed suggest that this technique may be extended to the study of configurations of free moleculars as well as the orientation of molecules adsorbed on surfaces.

28476 **Atomic physics on a synchrotron: crucial experiments.** Manson, S.T. (Georgia State Univ., Atlanta (USA)). pp 429-431 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Various types of synchrotron experiments in atomic and molecular physics are discussed. Among other things, these experiments bear on the three-body continuum Coulomb problem, strong correlation/multiple processes, photoabsorption by unusual states, and probes of small interactions.

28477 **Searching for exotic particles with a 3 MV accelerator.** McKeown, R.D. (California Institute of Technology, Pasadena (USA)). pp 454-456 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The Caltech 3 MV pelletron accelerator has been used in a variety of experiments to search for exotic particles which may be either stable or produced in nuclear decays. The techniques involve applications of accelerator mass spectrometry as well as more conventional nuclear spectroscopy. Topics of recent interest including the existence of fractionally charged particles, doubly-negative atomic ions, and neutral weakly-interacting pseudoscalars (axions) have been investigated.

28478 **Ion implantation Part II: ion implantation in nonelectronic materials.** Dearnaley, G. (Harwell Lab., Oxon (England)). pp 506-511 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Ion implantation provides a highly versatile means of modifying the near-surface composition of solids. Two principal areas of application have emerged so far: these are the improvement of wear resistance, especially under abrasive conditions, for steels, titanium alloys, tungsten carbide, etc., and the improvement of corrosion properties in the gas phase e.g. during thermal oxidation. Mechanisms by which these benefits are achieved are becoming better identified, but are relatively complex. Ion implantation has also become a valuable research tool for the preparation of materials in a nonequilibrium condition and for investigating impurity-defect interactions. Some of these are important in ion beam mixing and ion assisted coatings, both of these being techniques in which deposition is combined with ion implantation. Developments have taken place in the equipment for ion implantation of metals on an industrial scale, the second generation facilities now available providing substantially reduced unit costs by virtue of an increased scale of throughput.

28479 **Molecular decomposition of solid methane films and emission of molecular fragments under MeV ion bombardment.** Brown, W.L.; Lanzerotti, L.J.; Bower, J.E.; Marcantonio, K.J. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 512-516 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Electronic and collisional excitation of thin films of condensed molecular gases (H_2O, O_2, N_2, CO_2, NH_3, SO_2, CH_4, etc.) by MeV and keV ions results in sputtering of the primary molecules. In addition, new solid molecular species, formed from fragments of the original molecules, are also emitted. Solid methane is a particularly interesting case. Hydrogen is a principal emission product of methane as it is in the bombardment of all hydrocarbons. However, in methane electronically excited by MeV light ions, the major hydrogen release occurs only after a well defined threshold ion fluence. This suggests a percolation threshold for the escape of hydrogen: material modification of the solid methane must proceed to a point at which a continuous diffusion path of high diffusion coefficient exists to the surface from within the film before the major emission can take place. The threshold fluence depends on the excitation density along individual ion tracks in a non-linear way, higher stopping power ions being more efficient in reaching the threshold. Carbon is also lost from methane films but in a quantity which is a decreasing fraction in thicker films.

28480 **Ubiquity of C-H bond breaking by MeV ion irradiation.** Tombrello, T.A. (California Institute of Technology, Pasadena (USA)). pp 517-521 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Hydrocarbons are inadvertently present on the surfaces of most materials, and hydrogen is a major contaminant in amorphous carbon. These C-H bonds are easily broken by the electronic excitation induced by the passage of an energetic (MeV) ion, as seen, for example, in the registration of ion damage tracks in many organic materials. In this session of the conference they shall see that, when the C-H bonds are broken, structural modification of the material occurs. These structural changes include, for example, not only the loss of hydrogen, but also involve graphite formation in amorphous carbon and hydrocarbons, and surface or interface atom rearrangement in other materials. This effect is important not only in interactions with dirt but also as a phenomenon that can be exploited for the modification of material properties. They speculate herein that the effects observed can be accounted for by a model of the process based on damage induced by secondary electrons arising along the path of the beam ion. The simultaneous breaking of several adjacent C-H bonds by a number of these electrons allows stronger C-C or C-substrate atom bonds to form, which in turn produce atomic rearrangement. The freed hydrogen atoms eventually combine to form H_2 which diffuses from the material.

28481 **Chemical evolution of frozen methane by keV ion bombardment.** Foti, G.; Calcagno, L.; Zhou, F.Z.; Strazzulla, G. (Dipartimento di Fisica, Catania (Italy)). pp 522-525 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Frozen methane layers at low temperature (~ 10 K) have been irradiated with high energy ion beams (keV Ar^+ and He^+). Molecular emission of H_2, CH_4, C_2H_2, C_2H_4 and C_2H_6 has been detected as a function of ion fluence in the range 10^{14}-10^{16} ions/cm^2. Most of the original carbon atoms are bound after ion bombardment to form a hydrogenated amorphous carbon layer (solid residue) stable at high temperature.

28482 **Si-H and C-H bond breaking during MeV-ion bombardment of a native oxide of silicon.** Seiberling, L.E. (Univ. of Pennsylvania, Philadelphia (USA)). pp 526-530 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The authors have studied the native oxide of silicon (110) and the changes produced by MeV-ion bombardment. The number of Si atoms incorporated in the oxide was measured using transmission channeling of 5.9 MeV ^{9}Be ions through a thin Si sample. Concentrations of adsorbed H, C and O were measured using ion scattering and elastic recoil detection analysis (ERDA) techniques. The native oxide was found to be composed of 1/2 monolayer each of Si and O, with several monolayers each of H and C. Continued ^{9}Be ion bombardment was found to increase the amount of Si in the oxide, up to a saturation value of one monolayer. The O concentration increased with dose, so that the ratio of Si to O in the oxide remained approximately one. An exponential decrease in the H concentration was observed, with the concentration approaching roughly one monolayer at large doses. A Si native oxide at the interface of a (thick) Si wafer and a 220 A Ag layer was studied using 58 MeV Cu ion bombardment at a glancing angle through the Ag layer. The concentrations of H, C and O were measured using ERDA. In this case, the H concentration also decreased exponentially with ion dose. These results will be discussed in terms of possible irradiation-induced chemistry in the native oxide.

28483 **Radiation effects on the adhesion of NaCl to SiO_2.** Sofield, C.J.; Trehan, P.N.; Sugden, S. (Harwell Research Lab., Didcot (England)). pp 531-533 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The effect of radiation on the adhesion of NaCl films to SiO_2 (fused silica) has been studied. Irradiation with 2 MeV He^+ ions, 1-3 keV electrons, and 30 keV electrons has been investigated. The low energy electron irradiation gave rise to film decohesion whereas both the high energy He ion and electron irradiation improved adhesion.

28484 **Secondary electron emission from the entrance and exit surfaces of thin aluminium foils under fast light ion bombardment.** Da Silveira, E.F.; Jeronymo, J.M.F. (Pontificia Universidade Catolica, Rio de Janeiro (Brazil)). pp 534-537 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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The total secondary electron emission yield from the entrance and exit surfaces of thin aluminum foils has been measured for protons, deuterons and He beams in the MeV region. It is found that this yield for each surface decreases with the ion beam intensity and with the dose; the former may be due to a beam-induced temperature effect while the latter is attributed to an increase of the beam-induced contamination from adsorbed gases in the target. The ratio of total forward yield to the total backward yield is about a factor of 2 which is also observed to be approximately the ratio of the contamination rates of the exit surface to the entrance surface. This suggests the possibility that the secondary electron emission is directly related to the surface contamination rate.

28485 **Ion implantation for carrier lifetime control in silicon technology.** Mogro-Campero, A. (General Electric Research and Development Center, Schenectady, NY (USA)). pp 538-541 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Carrier lifetime characterizes the return to equilibrium in a semiconductor by recombination and generation of carriers. Its value affects the performance of many silicon devices. Ion implantation is an emerging method whereby lifetime can be reduced. A major advantage of this method is the possibility of three-dimensional localization of regions of low lifetime within devices and integrated circuits. Argon and proton implantation are discussed as examples of two different approaches to localization; one relies on thermal stability of damage, and the other on the nonuniform

energy deposition profile of ions coming to rest in matter. Proton implantation and electron irradiation are compared in an application of lifetime control to insulated gate transistors. It is shown that device performance is improved with proton implantation if the appropriate energy is used.

28486 **Icosahedral phase formation by ion beam alloying methods.** Follstaedt, D.M.; Knapp, J.A. (Sandia National Labs., Albuquerque, NM (USA)). pp 542-547 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC04-76DP00789.

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The use of ion beam mixing and ion implantation to produce and investigate icosahedral phases of Al alloyed with transition elements is reviewed. Results obtained with such solid-state methods demonstrate that reaction kinetics can favor icosahedral-phase formation in the solid state as well as in liquids during quenching. These studies also show the relationships between the icosahedral phase and the amorphous and crystalline states, and provide information on the atomic structure of icosahedral phases.

28487 **Electrical and structural changes in GaAs crystals from high-energy, heavy-ion implants.** Bardin, T.T.; Pronko, J.G.; Junga, F.A.; Opyd, W.G.; Mardinly, A.J.; Xiong, F.; Tombrello, T.A. (Lockheed Palo Alto Research Lab., CA (USA)). pp 548-553 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Changes in electrical properties and crystal structure due to MeV, heavy-ion implants in GaAs have been studied. The electrical properties of the implanted samples were obtained by measuring I-V characteristic curves on and through implanted regions and Seebeck potential differences across implanted regions. The changes in crystal structure induced by the implants were measured using RBS channeling experiments and XTEM micrographs. The RBS and XTEM results indicated that MeV ion doses $> 1 \times 10^{15}$ ions/cm^2 amorphized the crystal structure at the end of ion range. After annealing the GaAs sample, the amorphized region returned to a crystalline state but with many defect centers. In n-type doped GaAs both Cl^{3+} and O^{3+} ions induced acceptor like centers which became inactive after rapid thermal annealing. Most of the active electrical carriers can be attributed to crystal defects.

28488 **Temperature effect on the microhardness of Ti-overlaid 4145 steel implanted with nitrogen.** Knystautas, E.J.; Singh, A.; Fiset, M.; Gujrathi, S.; Lemay, L. (Universite Laval, Quebec (Canada)). pp 554-556 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Previous work has shown that nitrogen-ion implantation into Ti-overlaid 4145 steel increased surface microhardness when annealed for 20 min at moderate (300°C) but not high (600°C) temperatures. In the present work, evidence is presented which suggests that the disappearance of the hardening effect at the higher temperature is due to the almost total diffusion of the nitrogen out of the implanted region.

28489 **Metastable phase formation by ion beam mixing.** Was, G.S.; Eridon, J.M. (Univ. of Michigan, Ann Arbor (USA)). pp 557-561 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

There are essentially four basic types of metastable alloys which may be formed through heavy ion irradiation of crystalline structures: amorphous phases with no long range order; crystalline phases with structures different from that of the stable intermetallic alloy; disordered crystalline phases with structures based on the same lattice as that of the stable intermetallic; and a quasicrystalline structure. With the exception of the quasicrystalline structure, all of these metastable structures are produced by ion beam mixing of nickel-aluminum alloys with 500 keV krypton ions. Ion beam mixing was performed on samples formed by alternate evaporation of layers of nickel and aluminum as well as on the intermetallic compounds at both 80 and 300 K. The structure resulting from ion beam mixing depended strongly on composition, and hence its formation was governed primarily by thermodynamic considerations. The thermodynamically favored state was determined analytically using the embedded atom method, and the model results are in qualitative agreement with observations of metastable phase formation. However, kinetic considerations are needed to explain the dependence of the final structures on initial structure and temperature.

28490 **Defect strain fields in epitaxial GaAs.** Wie, C.R. (State Univ. of New York, Buffalo (USA)). pp 562-564 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Lattice strain in MeV ion bombarded III-V semiconductors saturates with high dose ($\sim$ 1E15 cm^{-2}) irradiation. The authors report that the lattice strain in bombarded samples is smaller in epitaxial GaAs samples than in corresponding bulk samples. Moreover, a pseudomorphic epilayer significantly changes the defect-induced strain in the underlying substrate crystals.

28491 **Surface engineering with ion-assisted coatings.** Legg, K.O. (Ionic Atlanta, Inc., GA (USA)). pp 565-567 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Ion-assisted coating (IAC) combines both ion implantation and coating techniques into an effective method of tailoring surface properties. Improvements arise partly for the same reasons that plasmas aid coatings, but with the additional advantages that the ion beam is well-controlled and highly efficient in imparting energy to the substrate surface and to the film. Without heating, it produces metal and ceramic coatings with broad ion beam mixed interfaces for good film adhesion, and permits direct chemical modification of the coating and substrate before, during, and after deposition. IAC processes can utilize different types of deposition systems; with an rf magnetron source, implanted coatings of nearly any material can be produced. IAC techniques will be briefly described; examples of different IAC applications and processes will be given, including metal films on ceramics and ion-assisted low temperature growth of very thin, highly adherent TiN films on metals which produce low friction, low wear surfaces.

28492 **Platinum loss and migration in porous gas diffusion fuel cell electrodes as studied by Rutherford backscattering spectrometry.** Borodovsky, L.; Beery, J.G.; Paffett, M. (Los Alamos National Lab., NM (USA)). pp 568-571 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Long-term operation of phosphoric acid fuel cells produces severe migration of the highly dispersed electrocatalyst, Pt, from the cathode to the anode. The authors have examined, before and after extended operation, the porous gas diffusion electrode assemblies by conventional Rutherford backscattering spectrometry using the ion beam facility at Los Alamos. In addition, they have made

computer simulations to the data that give catalyst concentration as a function of depth. The data demonstrate that after extended operation (500-2000 h), Pt is lost from the cathode and is redeposited at the outermost surface layers of the anode electrode structure. This loss is significant and several factors contributing to it will be discussed.

28493 Crystal orientation and sample preparation effects on sputtering and lattice damage in 100 keV self-irradiated copper. Sprague, J.A.; Malmberg, P.R.; Reynolds, G.W.; Lambert, J.M.; Treado, P.A.; Vincenz, A.M. (Naval Research Lab., Washington, DC (USA)). pp 572-574 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Sputtering yields and angular distributions have been measured as functions of sample preparation techniques and incident ion-beam orientation with respect to the crystal axes for 100 keV Cu-ion beams on Cu crystals and polycrystalline samples. The angular distributions have structure requiring an nth order cosine with two Gaussians superimposed to fit the data; strong peaking is observed near the backscatter direction. The yield is dependent on the beam to crystal and beam to polycrystalline-rod axis orientation, on the grain size of the polycrystals and on sample-preparation techniques. Yield measurements vary by as much as a factor of 4. Lattice-damage differences, measured with alpha particle channeling, are much smaller and seem to be saturated by fluences of the order of 1 x 10^{16}/cm^2.

28494 Comparison of rapid thermal annealing and controlled atmosphere annealing of ion implanted GaAs. Kanber, H. (Hughes Aircraft Co., Torrance, CA (USA)). pp 575-580 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Rapid thermal annealing (RTA) for the electrical activation of 100 keV and 300 keV Si^+ implants in GaAs at doses of 6-10 x 10^{13} cm^{-2} is compared to conventional capless furnace annealing under optimum conditions using the controlled atmosphere technique. RTA is shown to be superior to conventional annealing for deep 300 keV Si implants for which higher peak electron concentrations and higher gateless field-effect transistor (FET) saturation currents with better uniformities were measured. Essentially identical electrical characteristics are obtained for shallower 100 keV Si implants using optimized RTA conditions as compared to conventional annealing. The advantages of RTA for the removal of ion implementation damage in GaAs are attributed to the differences in the host lattice damage recovery resulting from heat transfer and the actual rapid heating rate to reach the desired anneal temperature.

28495 Optical measurement of the RMS roughness of ion-implanted surfaces. Correll, F.D.; Ferguson, C.D.; Kant, R.A. (Naval Academy, Annapolis, MD (USA)). pp 581-583 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Ion implantation and other ion-beam processing techniques sometimes roughen the surfaces to which they are applied. If undetected, such roughness can lead to erroneous interpretation of data gathered by RBS, AES, and other surface analysis techniques. Many surface profilometers and scanning electron microscopes lack sufficient resolution to detect fine-scale roughness that can complicate the data interpretation. The authors have constructed a simple optical instrument to measure the root-mean-square (rms) roughness, below ~ 100 nm, of ion-implanted surfaces. This instrument measures the total integrated scatter (TIS) of almost-normally incident laser light, which (under certain conditions) is simply related to the rms surface roughness. This paper describes the construction and calibration of the TIS instrument, and presents preliminary results on the roughness of Cr surfaces deposited under various vacuum conditions and implanted during deposition with energetic Cr ions.

28496 Quantitative measurement of film thickness, density and stoichiometry of multilayer thin films on thick substrates. Hichwa, B.P. (Donnelly Corp., Holland, MI (USA)). pp 584-586 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The analysis of multilayer thin films on thick substrates such as glass or plastics has been difficult to achieve with any accuracy or confidence. At Donnelly Corporation, a number of different multilayer thin film stacks are produced by a variety of methods (sputtering, e-beam, etc.). A knowledge of the physical properties of these films is essential. Film thicknesses typically vary from 10 to 400 nm and are measured by a mechanical surface profiling technique. The structure, density, and stoichiometry of the films are determined by a combination of Rutherford backscattering (RBS) and proton induced X-ray emission (PIXE) experiments. Exact RBS analysis techniques have been developed which, when combined with other analytical tools, have allowed thin film physical properties to be determined quantitatively. One key to this process is the multiple determination of energy loss in a given layer through the multilayer stack. In addition, for any given layer of a metal oxide, e.g., Ta_2O_5, the energy loss of the film constituents, which is proportional to the thickness of the film, is reflected by the width of the tantalum peak in the backscattered spectrum. The integrated area of the tantalum peak, however, is proportional to the tantalum content in the film, leading to a measurement of the film stoichiometry. A strong confidence has been developed in these techniques, since on a variety of standard thin film stacks, the results compare favorably with known values.

28497 Nuclear reaction analysis of materials after modification. Bethge, K. (J. W. Goethe-Universitaet, Frankfurt (West Germany)). pp 587-590 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Modifications of materials include mechanical, chemical or thermal treatment as well as irradiation. After such treatments the compositions and distributions of components (elements) may have changed. Depth profiling as well as lateral profiling by nuclear reactions allows the study of kinetics and in some cases the dynamics of the processes involved. For many materials the treatment as well as the analysis can be performed in situ as a function of the varying parameters mentioned. Composite sandwich targets (C-Th-C) as well as implanted metal samples were analyzed.

28498 Development of a dual-ion beam accelerator connected with a TEM for in situ observation of radiation-induced defects. Suzuki, K.; Shigenaka, N.; Hashimoto, T.; Nishimura, E. (Hitachi Ltd., Ibaraki (Japan)). pp 591-593 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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A dual-ion beam accelerator connected with a TEM has been developed for in situ observation of radiation-induced defects. The system consists of a 400-kV Cockcroft-Walton accelerator, which can accelerate two different kinds of ions alternatively, and a 200-kV TEM equipped with a high-sensitivity TV camera. The ion beam from the accelerator is fed into the TEM by an electrostatic beam transport system which consists of three deflectors, two qua-

drupole lenses and a 57° static prism. A copper specimen is bombarded with 150-keV Ar ions. A small cascade of < 5 nm in diameter is observed for an Ar-ion current of about 85 nA/cm². At a higher current of 1 μA/cm², recombination, growth, overlap, and collective motions of cascades are observed during irradiation. In situ observation of argon bubbles at a grain boundary of copper gives a diameter growth rate of 2.8 x 10^{-2} nm/s at a dose rate of 5.3 x 10^{14} Ar^+/cm^2 s and a temperature of about 500 K.

28499 **Ion channeling strain measurements InGaAs/InP quantum well structures.** Cole, J.M.; Earwaker, L.G.; Cullis, A.G.; Chew, N.G.; Bass, S.J.; Taylor, L.L. (Univ. of Birmingham (England)). pp 594-597 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

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Ion channeling results are presented for the analysis of In/sub 1-x/Ga/sub x/As/InP double quantum well (DQW) structures. Layer thicknesses and composition have been extracted from random direction Rutherford backscattering spectra and lattice strains in the InGaAs ternary alloys determined from the angular separation of the InGaAs and InP <110> channeling directions. The method of ion beam crystallography permits the direct measurement of the degree of tetragonal distortion. The comparison of the measured strain with theoretical limits corresponding to maximum strain accommodation with no misfit dislocation generation is discussed.

28500 **HVEM-Tandem accelerator facility at Argonne National Laboratory.** Taylor, A.; Allen, C.W.; Ryan, E.A. (Argonne National Lab., IL (USA)). pp 598-602 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract W-31-109-ENG-38.

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The HVEM-Tandem National User Facility consists of a modified Kratos/AE1 EM7 HVEM with a maximum accelerating voltage of 1.2 MeV, interfaced to both a 2MV National Electrostatics tandem ion accelerator and a 300 kV Texas Nuclear ion accelerator. The latter is being replaced with a 650 kV National Electrostatics accelerator which should be fully operational in FY 1987. These accelerators provide a wide range of ion species with energies from 25 keV to 8 MeV. The combination of HVEM and ion accelerators provides a truly unique capability for ion irradiation/implantation experimentation along with simultaneous microscopy. The HVEM-Tandem Facility currently is employed for a wide range of materials research, including basic in situ studies of mechanical properties, oxidation and hydrogen effects in metals, radiation effects including ion and electron irradiation-induced phase changes and general defect analysis. More than half of these studies are conducted by non-ANL scientists from universities and other national laboratories. Access to the National User Facility is by means of research proposals which are reviewed by a Steering Committee composed of both Argonne and non-Argonne scientists representing the user community.

28501 **Ion beam characterization of laser mirrors.** Beery, J.G. (Los Alamos National Lab., NM (USA)). pp 603-607 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Systems using high-power lasers require mirrors that will withstand fluence levels in the 10-50 J/cm² range without damage. One candidate for such reflectors is the multilayer, dielectric, quarter-wave stack design consisting of alternating layers, one of high refractive index and one of low refractive index. The authors are using ion beam techniques to characterize these dielectric reflectors before and after laser damage. These techniques are particularly suitable for measuring the composition of the mirrors as a function of depth, the presence of low concentration impurities, and changes in the structure of the films as results of the damage processes. The measurements have been made on undamaged coatings with beam spot sizes of a few mm². Localized structure in the region of individual damage pits have been studied with a nuclear microprobe that produces spot sizes as small as 10 μm in diameter.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 28357, 28727

28502 **(PB—88-160072/XAB) Numerical tests of a modified full implicit continuous Eulerian (FICE) scheme with projected normal characteristic boundary conditions for MHD (magnetohydrodynamic) flows.** Wu, S.T.; Wang, J.F. (Alabama Univ., Huntsville (USA). Dept. of Mechanical Engineering). 1987. 19p. NTIS, PC A03.

Pub. in Computer Methods in Applied Mechanics and Engineering, Vol. 64, No. 1-3, 267-282(Oct 1987).

A numerical method was developed based on a modified full implicit continuous Eulerian (FICE) scheme and projected normal characteristic boundary conditions for simulating magnetohydrodynamic (MHD) flows which undergo a long process of evolution. An astrophysical flow is chosen for illustration of the procedure, and numerical tests are made to verify the computational stability and physically realistic solution. Three computational tests were accomplished; they are tests of solving methods, characteristic boundary condition, and time steps. The tests show that the program from the modified FICE scheme with proper boundary consitions, and time steps. The tests show that the program from the modified FICE scheme with proper boundary consitions and time steps can be made numerically stable for a time long enough to obtain physically plausible solutions.

28503 **(PB—88-164868/XAB) Hartree phenomenology of the Bose glass.** Gunn, J.M.F.; Ortuno, M. (Rutherford Appleton Lab., Chilton (UK)). Nov 1987. 21p. (RAL—87-087). NTIS, PC E03/MF E03.

The authors formulate a Hartree phenomenology of the 'Bose Glass' in the localized phase and look for instabilities to Bose condensation. The nature of the instability depends on whether the interparticle interactions are Coulombic or hard core. In the latter case they map the problem onto an effective Anderson Model. It was found that the effective density of states can exhibit 'one dimensional van Hove singularities' which can trigger the condensation. The authors point out how spatial correlations among the single-particle localized states affect their conclusions.

28504 **Information transport in spatiotemporal systems.** Vastano, J.A.; Swinney, H.L. (Center for Nonlinear Dynamics and Department of Physics, The University of Texas, Austin, Texas 78712). *Physical Review Letters;* **60**: No. 18, 1773-1776(2 May 1988).

Spatiotemporal chaos can be produced by complicated local dynamics in a small spatial region and observed globally through a process we call information transport. Information transport can be detected by computation of an information-theoretic quantity, the time-delayed mutual information, between measurements of the system at separate spatial points.

28505 **Calculation of some Batchelor flows: The Sadovskii vortex and rotational corner flow.** Moore, D.W.; Saffman, P.G.; Tanveer, S. (Applied Mathematics, California Institute of Technology, Pasadena, California 91125). *Physics of Fluids;* **31**: No. 5, 978-990(May 1988).

Steady, inviscid, incompressible, two-dimensional flows with vortex patches bounded by vortex sheets (Batchelor flows) are calculated numerically. Two particular cases are considered: the vortex on a plane wall (Sadovskii vortex) and the vortex in a right-angled corner. Nonlinear integral equations are derived for the shape of the bounding vortex sheet which are solved numerically. Two different formulations are employed to check the results. Previous results by Sadovskii [Appl. Math. Mech. 35, 773 (1971)] and Chernyshenko (Royal Aircraft Establishment library translations

Report No. 2133, 1983) for specific values of the parameters are confirmed. Only symmetrical solutions are found to exist.

28506 **Random-vortex simulation of transient wall-driven flow in a rectangular enclosure.** Choi, Y.; Humphrey, J.A.C.; Sherman, F.S. (Department of Mechanical Engineering, University of California, Berkeley, California 94720). *Journal of Computational Physics;* **75**: No. 2, 359-383(Apr 1988).

Two-dimensional transient flow in square cavity, following impulsive acceleration of the sliding wall, is simulated by random-vortex calculations of the type initiated by A. Chorin. Comparison calculations are made using a transient finite-difference method that is first-order accurate in time and second-order accurate in space. The Reynolds number, R, based on the sliding wall length and speed, is 2000, 5000, or 10.000. The simulated history starts when the moving wall starts, ends when the wall has moved three times its length, and shows the development of primary and secondary eddies in the corner where the boundary layer on the moving wall is peeled off by the stationary wall. Special features of this random-vortex simulation include: (1) the use of the closed-form expression for the velocity induced by a line vortex in a rectangular enclosure; (20 special treatment of regions very close to the corners where the sheet-like elements, ordinarily used in a very thin wall layer, are inappropriate; and (3) the generation of a small (three-member) ensemble of simulations at each Reynolds number. Comparisons between the two numerical schemes were made at Reynolds numbers of 2000 and 5000. A comparison with experimental data of Koseff is given for R = 2000. Both numerical methods exhibited the same qualitative flow features and were in fair quantitative agreement. The random-vortex calculations show somewhat better agreement with the laboratory experiment. copyright 1988 Academic Press, Inc.

28507 **Ringing instability in particle-in-cell calculations of low-speed flow.** Brackbill, J.U. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* **75**: No. 2, 469-492(Apr 1988).

The cause of the ringing instability in particle-in-cell (PIC) fluid calculations is identified, and its properties are studied. The ringing instability is caused by aliasing, just as is the finite grid instability previously identified in PIC plasma simulation, and results in large amplitude fluctuations in the particle density. The instability occurs when the flow speed drops below a critical value, which is lower with higher order interpolation and zero with Gaussian interpolation. The instability growth rate is only weakly dependent on the number of particles per cell, but appears to be suppressed by implicit differencing in time. copyright 1988 Academic Press, Inc.

28508 **Upwind differencing scheme for the equations of ideal magnetohydrodynamics.** Brio, M.; Wu, C.C. (Department of Physics, University of California, Los Angeles, California 90024). *Journal of Computational Physics;* **75**: No. 2, 400-422(Apr 1988).

Recently, upwind differencing schemes have become very popular for solving hyperbolic partial differential equations, especially when discontinuities exist in the solutions. Among many upwind schemes successfully applied to the problems in gas dynamics, Roe's method stands out for its relative simplicity and clarity of the underlying physical model. In this paper, an upwind differencing scheme of Roe-type for the MHD equations is constructed. In each computational cell, the problem is first linearized around some averaged state which preserves the flux differences. Then the solution is advanced in time by computing the wave contributions to the flux at the cell interfaces. One crucial task of the linearization procedure is the construction of a Roe matrix. For the special case $\gamma = 2$, a Roe matrix in the form of a mean value Jacobian is found, and for the general case, a simple averaging procedure is introduced. All other necessary ingredients of the construction, which include eigenvalues, and a complete set of right eigenvectors of the Roe matrix and decomposition coefficients are presented. As a numerical example, we chose a coplanar MHD Riemann problem. The problem is solved by the newly constructed second-order upwind scheme as well as by the Lax-Friedrichs, the Lax-Wendroff, and the flux-corrected transport schemes. The results demonstrate several advantages of the upwind scheme. In this paper, we also show that the MHD equations are nonconvex. This is a contrast to the general belief that the fast and slow waves are like sound waves in the Euler equations. As a consequence, the wave structure becomes more complicated; for example, compound waves consisting of a shock and attached to it a rarefaction wave of the same family can exist in MHD. copyright 1988 Academic Press, Inc.

28509 **Numerical solution of three-dimensional magnetic differential equations.** Reiman, A.H.; Greenside, H.S. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Computational Physics;* **75**: No. 2, 423-443(Apr 1988).

A computer code is described that solves differential equations of the form B x delf = h for a single-valued solution f, given a toroidal three-dimensional divergence-free field B and a single-valued function h. The code uses a new algorithm that Fourier decomposes a given function in a set of flux coordinates in which the field lines are straight. The algorithm automatically adjusts the required integration lengths to compensate for proximity to low order rational surfaces. Applying this algorithm to the Cartesian coordinates defines a transformation to magnetic coordinates, in which the magnetic differential equation can be accurately solved. Our method is illustrated by calculating the Pfirsch—Schlueter currents for a stellarator. copyright 1988 Academic Press, Inc.

28510 **Two-dimensional MHD simulations of magnetic field penetration in the plasma opening switch.** Payne, S.S.; Hussey, T.W.; Stinnett, R.W.; Roderick, N.F. (Sandia National Labs., Albuquerque, NM 87185 (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 6, 725-734(Dec 1987).

Three mechanisms for anomalous magnetic field penetration have been investigated in computer simulations of Sandia's plasma opening switch (POS). The POS simulations have been performed using the two-dimensional (2-D) two-temperature single-fluid magnetohydrodynamic (MHD) code HAM [1], [2]. The three penetration mechanisms considered are 1) the Chodura model based on the ion-acoustic instability where the saturated value of the anomalous collision frequency is approximated by the ion plasma frequency; 2) a model based on the lower hybrid instability in which the anomalous collision frequency is proportional to both the ion plasma frequency and the electron drift velocity; and 3) a model that limits the ion drift velocity to the plasma influx velocity. Two-dimensional MHD calculations of the POS will be presented which show these models to be qualitatively similar for densities above a few 10/sup 13/ cm/sup -3/, though at lower densities they can be quite different. The calculations are compared to experiments, and some agreement is seen with the lower hybrid model. The other models compare only marginally to experimental results.

28511 **Fluid simulation of the conduction phase of the plasma erosion opening switch.** Grossmann, J.M.; Mosher, D.; Ottinger, P.F. (Naval Research Lab., Washington, DC 20375-5000 (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 6, 704-714(Dec 1987).

The conduction phase of the plasma erosion openings switch (PEOS) is studied using a 1 1/2-D electromagnetic two-fluid code. The focus of this work is on understanding how two effects, a current-limiting model of electron emission, and the magnetic insulation of electrons at the cathode, determine current conduction in the plasma. Simulations are performed in the parameter regimes of the Gamble I, POP, and PBFA II pulsed power generators, and previous low-density, short-rise time simulations of the PEOS. Fluid code results are compared to a 1-D analytic theory and to the Gamble I and POP experiments. Good agreement between theory and simulation, but mixed agreement between simulation and experiment is found. Experimental B-field measurements on POP show weaker j x B compression than the simulation. Current penetration and plasma current channels qualitatively similar to experimental observation are found in the Gamble I regime. However, magnetic insulation of electrons emitted from the cathode bunches the electron flow into narrower current channels than observed experimentally. In several cases, the presence of an electron-scattering or

energy-loss mechanism near the cathode must be invoked to overcome magnetic insulation and widen the current channels.

28512 Implicit collisional three-fluid simulation of the plasma erosion opening switch. Mason, R.J.; Wallace, J.M.; Grossmann, J.M.; Ottinger, P.F. (Los Alamos National Lab., Los Alamos, NM 87545 (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 6, 715-724(Dec 1987). Contract W-7405-ENG-36.

The plasma erosion opening switch (PEOS) has been studied with the aid of the ANTHEM implicit simulation code. This switch consists of fill plasma injected into a transmission line. The plasma is ultimately removed by self-electrical forces, permitting energy delivery to a load. Here, ANTHEM treats the ions and electrons of the fill plasma and the electrons emitted from the transmission-line cathode as three distinct Eulerian fluids - with electron inertia retained. This permits analysis of charge separation effects, and avoids the singularities that plague conventional MHD codes at low density. E and B fields are computed by the implicit moment method, allowing for time steps well in excess of the electron plasma period $\Delta t >> \omega/sub\ rho//sup\ -1/$, and cells much wider than a Debye length, $\Delta chi >> \lambda/sub\ D/$. Switch dynamics are modeled as a function of the driving electrical pulse characteristics, the fill plasma parameters, and the emission properties of the transmission line walls - for both collisionless and anomalously collisional electrons. Our low-fill-density ($n/sub\ e/ \leqq 4 X 10/sup\ 12/$ electrons/cm/sup 3/) collisionless calculations are in accord with earlier particle code results. Our high-density computations ($n/sub\ e/ \geqq 2 X 10/sup\ 13/$ electrons/cm/sup 3/) show the opening of the switch proceeding through both ion erosion and magnetic pressure effects. The addition of anomalous electron collisions is found to diffuse the driving B field into the fill plasma, producing broad current channels and reduced magnetic pressure effects, in some agreement with NRL experimental measurements.

28513 A self-similar model for conduction in the plasma erosion opening switch. Mosher, D.; Grossmann, J.M.; Ottinger, P.F.; Colombant, D.G. (Naval Research Lab., Washington, DC 20375-5000 (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 6, 695-703(Dec 1987).

The conduction phase of the plasma erosion opening switch (PEOS) is characterized by combining a 1-D fluid model for plasma hydrodynamics, Maxwell's equations, and a 2-D electron-orbit analysis. A self-similar approximation for the plasma and field variables permits analytic expressions for their space and time variations to be derived. It is shown that a combination of axial MHD compression and magnetic insulation of high-energy electrons emitted from the switch cathode can control the character of switch conduction. The analysis highlights the need to include additional phenomena for accurate fluid modeling of PEOS conduction.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 28548

28514 (INIS-mf—11197) Multiplicities in phase space intervals and Bose-Einstein correlations in hadronic interactions at 250 GeV/c. Meijers, F. (Katholieke Univ. Nijmegen (Netherlands)). 1 May 1987. 157p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702374/JAW.

Contains summary in Dutch.

This thesis describes a number of aspects of multiparticle production in $\pi/sup\ +/p$, $K/sup\ +/p$ and pp collisions at an incident beam momentum of 250 GeV/c. The corresponding centre of mass energy is 21.7 GeV. The experimental data have been collected with the European Hybrid Spectrometer at CERN. The experimental set-up and data processing chain are described in chapter 2. Chapter 3 concerns the methods used for the charged particle identification in the experiment. The analysis of the properties of the particle collisions starts in chapter 4. Here, a study of the multiplicity distribution in phase space intervals is presented. This analysis is done for the non-single-diffractive $\pi/sup\ +/p$ and pp collisions. In general the data can be well described by negative binomial distributions. This holds in particular for central regions of rapidity. However, also indication is seen for the existence of correlations in the data beyond those already absorbed into negative binomials. It is shown that the interpretation of the negative binominal distribution in terms of a cascading rather than the stimulated emission mechanism is favoured. The data are, furthermore, compared with results at other energies and another type of collision. As a consequence of the requirement of a symmetric wave function for identical pions, the probability for two identical pions to be close in phase space is enhanced compared to what is expected for non-identical particles under the same conditions. These Bose-Einstein correlations are studied in chapter 5 for the combined $\pi/sup\ +/p$ and $K/sup\ +/p$ sample. In particular, the interference effect has been studied with different reference samples and with different parametrisations of the effect. 108 refs.; 57 figs.; 23 tabs.

28515 (JINR-R—1-87-439) Charge dependence of the effective mass spectra of $\pi/sup\ +$-/p in π/sup -/C cumulative interactions at P=40 GeV/c with the total breakup of a nucleus. Anoshin, A.I.; Fadeev, N.G.; Cheplakov, A.P. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702439/JAW.

The inelastic π/sup -/C interaction multiplicity having anomalous peak at 60 deg C in the angular distribution of emitted protons in the laboratory system have been investigated. The effective mass distributions of $\pi/sup\ +/p$ and π/sup -/p pairs indicate a sharp dip for $\pi/sup\ +/p$ and sharp peak for π/sup -/p pairs at $M/sub\ eff/=(1300+-20)$ MeV for the protons from the angular anomalous region. Such a behaviour of the effective mass spectra could be due to the dynamics of generation of the nuclear shock wave in an electroneutral part of flucton. 8 refs.; 3 figs.; 3 tabs.

28516 (PCCF-T—87-05) Application of the discriminant analysis method to the recognition of jets and the nature of partons in the e/sup +/e/sup -/ hadrons reactions. Mjahed, M. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire; Clermont-Ferrand-2 Univ., 63 - Aubiere (France)). Jun 1987. 177p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753187/JAW.

In e/sup +/e/sup -/ annihilation process, the jets are produced by the fragmentation of various partons: the six flavours of quarks (u, d, s, c and the hypothetic top quark) and from the gluon. They form, according to the processus of production (e/sup +/e/sup -/ ->, qantiq, qantiqg, qantiqgg, qantiqqantiq) 2, 3, 4... jet events. Those jets are characterized by cinematical variables: sphericity, thrust, aplanarity, transverse momentum, charge, the fastest particle or the direction of jets. The identification of the variety of events or jets, by chosen variables taken one by one is not generally sufficient. The discriminant analysis method we used allows correlation of the greatest set of variables and the finding of the axis or the discriminant function, by which the classes of events or jets are discriminated. With the application of the method to the e/sup +/e/sup -/ -> hadrons reactions we can: - identify quark top events - determine the number of jets in u, d, s, c or b events - distinguish between quark jets and gluon jets -recognize the flavours of quark jets. The analysis is done at high energy (LEP) and based on a Monte-Carlo simulation with the Lund code, and for the first two points a simulation with constraint coming from the apparatus of detector ALEPH. The discriminant functions give an excellent separation of the different processes and can be used for real data (LEP...) The method can be used to other reactions: pantip, ep.

28517 Limits on the existence of a material-dependent intermediate-range force. Fitch, V.L.; Isaila, M.V.; Palmer, M.A. (Department of Physics, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* **60**: No. 18, 1801-1804(2 May 1988).

We have performed an Eoetvoes-type experiment at a site with a significant slope in the terrain. For an intermediate-range

force coupled to baryon number (N+Z) we find the product of strength α_0 and range λ to be $\alpha_0\lambda$ = -0.04 +- 0.07 m for $25<\lambda<400$ m. At greater ranges the value and the error increase linearly to $\alpha_0\lambda$ = -0.05 +- 0.09 m at 1.6 km. If the coupling is quark-flavor dependent, i.e., is purely to N-Z, we find, to well within the error, the same values for $\alpha_0\lambda$.terior

28518 Measurement of the spin correlation parameters A/sub l//sub l/ and A/sub s//sub l/ for the reaction pp→dπ⁺ in the energy region 500—800 MeV. Barlow, D.B.; Saha, A.; Seth, K.K.; Bhatia, T.S.; Glass, G.; Hiebert, J.C.; Kenefick, R.A.; Nath, S.; Northcliffe, L.C.; Tippens, W.B.; and others. (Northwestern University, Evanston, Illinois 60201). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 5, 1977-1986(May 1988).

Angular distributions of the spin-correlation parameters A/sub s//sub l/ and A/sub l//sub l/ for the reaction pp→π⁺d have been measured at pion center-of-mass angles $40^\circ \leq \theta/\text{sub } \pi//\text{sub } =//\text{sup } */\leq 130^\circ$ at incident energies of 500, 650, and 800 MeV. Additional measurements of A/sub l//sub l/ were made at 600, 700, and 750 MeV. The results of the experiment are compared with the predictions of several unified coupled-channel calculations and partial-wave analyses. While the latest partial-wave analyses were found to fit the data reasonably well, all except one of the various model predictions not only do not fit the data well, but also tend to be in disagreement with each other. The data show no clear sign of a need for proposed dibaryon resonances.

28519 Spin dependence of pp inelasticities at intermediate energies. Tanaka, N.; Gazzaly, M.M.; Pauletta, G.; Aas, B.; Adams, D.; Fujisawa, H.; Greene, S.; Hasai, H.; Igo, G.; Isagawa, S.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 University of Minnesota, Minneapolis, Minnesota 55455 University of Texas, Austin, Texas 78712 University of Udine, Udine, UD 33100, Italy University of California, Los Angeles, California 90024 Hiroshima University, Hiroshima, Japan National). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 5, 2071-2074(May 1988).

The asymmetries A/sub N//sub N/ and A/sub L//sub L/ have been measured at small angles for the p-arrow-right p-arrow-right→dπ⁺ reaction at 650 and 800 MeV. Now complete angular distributions are integrated to obtain the contribution of this channel to $\Delta\sigma$/sub L/. These contributions are combined with those from the elastic channel to determine $\Delta\sigma$/sub L/(p-arrow-right p-arrow-right→NNπ) at 650 (= 0.775 +- 0.5 mb) and 800 (= -1.52 +- 0.6 mb) MeV. There is pronounced disagreement between these data and the predictions of conventional theories. A/sub N//sub N/ and A/sub L//sub L/ also compared with theoretical predictions and their influence on partial-wave analyses is discussed.

28520 Measurement of the tau lifetime. Amidei, D.; Trilling, G.H.; Abrams, G.S.; Baden, A.R.; Boyer, J.; Butler, F.; Gidal, G.; Gold, M.K.; Goldhaber, G.; Golding, L.; and others. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 7, 1750-1757(1 Apr 1988). Contract AC03-76SF00098;AC03-76SF00515;AC02-76ER03064.

We have used a high-resolution drift chamber in the Mark II detector at the SLAC storage ring PEP to measure the lifetime of tau leptons produced in e^+e^- annihilations at 29 GeV. Based on the flight-path distribution of 807 three-prong tau decays, the lifetime is found to be (2.88 +- 0.16 +- 0.17) x 10/sup -13/ sec, in agreement with expectations for e-μ-tau universality.

28521 Search for the decay D⁰→e⁺e⁻ chamber . Adler, J.; Becker, J.J.; Blaylock, G.T.; Bolton, T.; Brient, J.C.; Brown, J.S.; Bunnell, K.O.; Burchell, M.; Burnett, T.H.; Cassell, R.E.; and others. (California Institute of Technology, Pasadena, California 91125). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 7, 2023-2025(1 Apr 1988).

We report a search for the decay $D^0\rightarrow e^+e^-$ based on a data sample of 9.6 pb/sup -1/ collected at the psi(3770) resonance with the Mark III detector at the SLAC e^+e^- storage ring SPEAR. We find no evidence for this flavor-changing weak-neutral-current decay and set an upper limit on the branching ratio of $B(D^0\rightarrow e^+e^-) < 1.3 \times 10/\text{sup } -4/$ at the 90% confidence level. This limit constrains various extensions of the standard model.

28522 Neutron-proton scattering observables at 325 MeV, the εY parameter, and the tensor force. Chulick, G.S.; Elster, C.; Machleidt, R.; Picklesimer, A.; Thaler, R.M. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545; Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106; Department of Physics, Kent State University, Kent, Ohio 44242; Department of Physics, University of California at Los Angeles, Los Angeles, California). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 4, 1549-1553(Apr 1988). Contract W-7405-ENG-36.

The sensitivity of neutron-proton elastic scattering observables to variations in the low angular momentum T = 0 phase shifts is studied at E/sub lab/ = 325 MeV. It is found that the J = 1 coupling parameter ϵ_1 is not well determined by existing data. This uncertainty in ϵ_1 permits models with quite different tensor forces to describe the extant data. Implications and possible experimental resolution of such ambiguities are discussed.

28523 Study of D⁰-D-bar⁰ mixing. Anjos, J.C.; Appel, J.A.; Bean, A.; Bracker, S.B.; Browder, T.E.; Cremaldi, L.M.; Elliott, J.R.; Escobar, C.O.; Estabrooks, P.; Gibney, M.C. (University of California, Santa Barbara, California 93106; Carleton University, Ottawa, Ontario K1Schemical bond5B6, Canada; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil; University of Colorado, Boulder, Colorado 80309; Fermi National Accelerator Laboratory, Batavia, Illinois 60510; National). *Physical Review Letters;* **60**: No. 13, 1239-1242(28 Mar 1988).

We present a study of D^0 mixing using events of the type $D/\text{sup } */+\rightarrow\pi^+D^0$, with $D^0\rightarrow K^+\pi^-$ and $D^0\rightarrow K^+\pi^-\pi^+\pi^-$. The decay time is used to separate mixing from doubly Cabibbo-suppressed decays. We observe no evidence for mixing in either mode. Combining the results from the two decay modes, we find $r/\text{sub } M/ = 0.0005 +- 0.0020$ or $r/\text{sub } M/ < 0.0037$ at the 90% confidence level, where r/sub M/ is the ratio of wrong-sign decays from mixing to right-sign decays. We also present limits on doubly Cabibbo-suppressed decays and consider the effect of possible interference.

28524 Production of G(1590) in 300 GeV central π/sup -/N collisions. Alde, D.; Knapp, E.A.; Bellazzini, R.; Brez, A.; Massai, M.M.; Torquati, M.R.; Binon, F.G.; Bricman, C.; Lagnaux, J.P.; Stroot, J.P. (Los Alamos National Lab., NM (USA); Pisa Univ. (Italy); Istituto Nazionale di Fisica Nucleare, Pisa (Italy); Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)). *Physics Letters* [*Section*] *B;* **201**: No. 1, 160-164(28 Jan 1988).

Significant production of G(1590), a scalar glueball candidate, is observed in a study of eta pairs produced in π/sup -/N central collisions at 300 GeV/c.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 28516, 28635, 28643, 28712

28525 (GSI—87-22) Nonlinear Dirac equation and the study of effective many-particle interactions in QED. Ionescu, D.C. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.)). Dec 1987. 137p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753238/JAW.

The starting point of the discussion was extended Lagrangian density for the classical Dirac field. The considered additional terms we had thereby interpreted as effective interactions because the corresponding field theory was not renormalizable. A scalar coupling as well as a vectorial coupling were put into calculation. The equation of motion for the system was thereby a one-particle equation which separated for s/sub 1/2/ and p/sub 1/2/ states and

led to a system of coupled differential equations for the radial part. The derived radial equations were studied on three different levels. First we considered ordinary systems from atomic physics with ordinal numbers Z ≦ 110 in order to obtain from precision experiments of quantum electrodynamics upper bounds for the coupling constants. Second we have studied the influence of these additional interactions on the energy levels of the superheavy systems with ordinal numbers 110 ≦ Z ≦ 190. Third we have searched for bound states of a nonlinear Dirac equation which should exist only because of the effective interaction. In the further study we have then changed to a field-quantized consideration because our hitherto analysis was purely classical. In this connection we have studied the (e/sup +/e/sup -/)/sup 2/ system with a (anti PSIΓPSI)/sup 2/ interaction. From the corresponding many-particle equation we have then by means of the Hartree-Fock method derived the one-particle equation of the system. Finally we had studied the electron-positron interaction by exchange of a massive intermediate vector boson. (orig./HSI).

28526 (IC—87/226) Lower and upper bounds on the mass of Higgs boson in SU(2) gauge theory. Ni Guangjiong; Lou Senyue; Chen Suqing. (International Centre for Theoretical Physics, Trieste (Italy); Fudan Univ., Shanghai, SH (China). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702254/JAW.

Using the method of the gaussian effective potential, we analyze the Higgs mechanism of SU(2) gauge theory in quantum version. We obtain an estimation of lower and upper bounds on the mass of Higgs scalar boson 0.978 m/sub W/ < m/sub H/ < 1.60 m/sub W/. If the mass of charged vector boson m/sub W/ = 82 GeV, then 80.2 GeV < m/sub H/ < 131 GeV. (author). 16 refs.

28527 (INIS-mf—11202) Perturbative calculations in the Higgs-sector of the standard model. Hoogeveen, F. (Amsterdam Univ. (Netherlands)). 3 Sep 1986. 64p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702379/JAW.

Contains summary in Dutch and previously published material.

In this thesis four separate calculations are collected. In chapter II the production cross section of the Higgs boson pairs in e/sup +/e/sup -/ collisions is calculated. For a not too heavy Higgs boson, production in association with a relatively heavy particle such as a top quark or a vector boson has a relatively high cross section. Production of a Higgs boson in association with another Higgs boson, i.e. pair-production, turns out to be an exception to this rule. In chapter III Higgs boson production is considered in case of p anti p collisions. Here it is found that in case the Higgs boson decays into two quarks there is an important contribution from the interference with the direct QCD production of a quark pair. These interference effects reduce the cross section appreciably, and make the process much harder to detect experimentally. In chapter IV the influence of a heavy quark doublet on this process is considered. It is well known that a heavy quark doublet does not decouple from this process, but it is shown that perturbation theory in this case has only a rather limited region of validity. In chapter V the influence of a heavy quark doublet on weak interaction parameters such as the rho-parameter and the vector boson mass shift is evaluated to two loop order. The previously existing limit on the mass difference in a heavy quark doublet is tightened slightly and due to the fact that the approximate SU(2)/sub R/ symmetry is broken at the two loop level limits on a mass degenerate quark doublet are also obtained. These limits, however, depend on the mass of the Higgs boson. 55 refs.; 24 figs.

28528 (ITP—86-117) Single spin asymmetries in perturbative QCD. Snigirev, A.M.; Zinov'ev, G.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702418/JAW.

Single spin asymmetry is calculated in the quark-antiquark subprocess. It is shown that the asymmetry is large enough and can manifest itself in hadron reactions. 5 refs.; 2 figs.

28529 (JINR-R—2-87-96) About weak pair correlations of identical pions outside the interference peak region. Podgoretskij, M.I.; Cheplakov, A.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702440/JAW.

The ratio of experimental to the background distribution is measured studying identical pion correlations. For a large momentum difference Δ the ratio is usually assumed to be independent of Δ because of the absence of interference peak. The accurate analysis shows that the constant should be replaced by slowly changing factors (1+μΔ/sup 2/) or (1+μΔ). This agrees with the high statistics experiments. 8 refs.; 1 fig.

28530 (JINR-R—2-87-135) Scales of longitudinal distances at high energies. Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702441/JAW.

Some approaches used to describe experimental data on particle interaction at high energies are considered. It is noted that these approaches obtain physical meaning only taken into account a concept of relativistic length. It is stressed that linear growth of longitudinal distances with increasing Lorentz factor corresponds to the results of experiments on the study of the effect of motion on space dimensions of identical pion generation regions. The obtained indication to the increasing of the corresponding longitudinal size as a result of motion could serve as the most direct evidence in favour of relativistic "elongation formula". It is also noted that the latter formula reflects the behaviour of fast-moving relativistic strings. 16 refs.

28531 (NIKHEF-H—87-15) Quarkonium production in hadronic interactions: probing the gluon structure function at small x values. Eijk, B. van; Kinnunen, R. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H; Helsinki Univ. (Finland). Dept. of High Energy Physics). (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Jun 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702474/JAW.

The production and decays of heavy flavour bound states have recently been implemented in the EUROJET Monte Carlo program for hadronic interactions. The matrix elements that describe the production of heavy quarkonia in p anti p interactions are based on fixed order perturbative QCD in combination with the nonrelativistic quarkonium model. The decays of the bound states are a compilation of experimental data and theoretical models. We present a detailed study on J/PSI and Y production at presently available collider energies and compare our results with data recently obtained at the UA1 experiment. Since the bound states are mainly produced via gluon interactions we discuss the sensitivity of the production cross-sections on the parametrization of the gluon structure function in the colliding protons. We conclude with an extensive list of quarkonium cross-section expectations for future hadron colliders and point out that the limited knowledge on the gluon structure function at small values of x is the main source of uncertainties in our predictions. 14 refs.; 13 figs.; 5 tabs.

28532 (NORDITA—88/4-P(prepr.)) Vacuum polarization and the meson Z/sup 0/. Hamilton, J. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). 1988. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753290/JAW.

The role of large vacuum polarization is discussed in relation to the theory of Salam and Weinberg. The vector dominance model is applied to Z/sup 0/, and a novel electromagnetic mass shift is suggested. A simple device is used for the standard renormalization of the photon propagator.

28533 Family mass hierarchy from universal seesaw mechanism. Davidson, A.; Wali, K.C. (Physics Department, Syracuse University, Syracuse, New York 13244). *Physical Review Letters;* **60**: No. 18, 1813-1816(2 May 1988).

The "universal seesaw mechanism," which accounts for m/ sub e//sub ,//sub u//sub ,//sub d/<<m/sub W/, predicts m/sub ν//sub >//sub L/m/sub ν//sub >R/≅m/sub e/². Combined with an axial-vector symmetry principle, this mechanism allows for the coexistence of heavy (approx. <m/sub W/) families without appeal to a hierarchy in Yukawa couplings and without introduction of additional mass scales. It then follows that (i) the physical right-handed heavy (light) ordinary fermions are mostly SU(2)/sub R/ singlets (doublets), (ii) there is no analogous neutrino mass hierarchy, and (iii) m/sub PQ/m/sub ν//sub >L/≅m/sub W/² sets the Peccei-Quinn mass scale.

28534 Lattice calculation of glueball-meson mixing. Gocksch, A.; Heller, U.M. (Physics Department, University of California at San Diego, La Jolla, California 92093). *Physical Review Letters;* **60**: No. 18, 1809-1812(2 May 1988).

We study the mixing of the 0/sup ++/ glueball with a meson of the same quantum numbers in the framework of lattice QCD. The effects of dynamical quarks of bare mass ma = 0.1 are taken into account by the pseudofermoin method. When confronted with a simple two-state mixing model our data are best interpreted as showing no evidence for mixing at the relatively large bare mass used.

28535 Hamiltonian light-front dynamics of elastic electron-deuteron scattering. Chung, P.L.; Coester, F.; Keister, B.D.; Polyzou, W.N. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242 Physics Division, Argonne National Laboratory, Argonne, Illinois 60439 Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 5, 2000-2015(May 1988). Contract W-31-109-ENG-38;.

Relativistic calculations of elastic electromagnetic form factors of the deuteron are presented for momentum transfers up to 8 GeV². Standard nucleon-nucleon interactions are used to construct a unitary representation of the inhomogeneous Lorentz group on the two-nucleon Hilbert space. Deuteron wave functions represent eigenstates of the four-momentum operator. Existing parametrizations of measured single-nucleon form factors are used to construct a conserved covariant electromagnetic current operator. Deuteron form factors are computed in terms of matrix elements of the current operator and the deuteron wave functions. The results are compared to experiment. The size of relativistic effects, scaling behavior, sensitivity to the nucleon-nucleon interactions, and effects of the uncertainties in measured nucleon form factors are investigated.

28536 Physical content of pseudopotential interactions. Macfarlane, M.H.; Redish, E.F. (Nuclear Theory Center and Physics Department, Indiana University, Bloomington, Indiana 47405). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 5, 2245-2248(May 1988).

The partial wave decomposition of the Franey-Love effective nucleon-nucleon amplitude is used to show that it satisfies on-shell unitarity to better than 5% in all partial waves, but its off-shell continuations are strikingly nonunitary.

28537 Heavy leptons and the electric dipole moment of the electron. Fabbrichesi, M.; Fishbane, P.M.; Norton, R.E. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 7, 1942-1949(1 Apr 1988).

The mass mixing of both the neutral and charged standard leptons with new, heavy, isosinglet leptons induces CP violation in the leptonic sector. Within values for the mass parameters which are consistent with present limits on family-mixing leptonic processes, we find that the electric dipole moment of the electron in such a model could be as large as 10/sup -27/ e cm.

28538 Derivation of the formalism for neutrino matter oscillations from the neutrino relativistic field equations. Mannheim, P.D. (Laboratory for High Energy Astrophysics, NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 7, 1935-1941(1 Apr 1988).

We derive the standard formalism of Mikheyev, Smirnov, and Wolfenstein for the oscillation of neutrinos in matter taking into account the Lorentz and second-quantized structure of the neutrino fields. We consider neutrinos with Dirac or Majorana masses.

28539 Improving the heavy-Higgs-boson two-charged-lepton—two-neutrino signal. Barger, V.; Han, T.; Phillips, R.J.N. (Physics Department, University of Wisconsin—Madison, Madison, Wisconsin 53706). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 7, 2005-2008(1 Apr 1988).

If the Higgs scalar boson H^0 has a mass greater than 600 GeV, severe difficulties have been foreseen in identifying it in pp collisions at the Superconducting Super Collider. We show that the $H^0 \to ZZ$ signal, with one $Z \to l^+l^-$ and one $Z \to \nu\bar{\nu}$ decay, can be separated from background by selecting events with l^+l^- at the Z mass plus large missing p/sub T/ plus two jets. This signal is enhanced by using an improved transverse-mass variable.

28540 Potentially large contributions to the muon anomalous magnetic moment from weak-isosinglet squarks in E_6 superstring models. Morris, D.A. (California Institute of Technology, Pasadena, California 91125). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 7, 2012-2014(1 Apr 1988).

We examine contributions to the anomalous magnetic moment of the muon from weak-isosinglet squarks found in E_6 superstring models. We find that such contributions are up to 2 orders of magnitude larger than those previously calculated and correspondingly require smaller Yukawa couplings in order to maintain agreement with the measured muon anomalous magnetic moment.

28541 Momentum correlations in heavy-quark hadroproduction. Berger, E.L. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 7, 1810-1817(1 Apr 1988). Contract W-31-109-ENG-38.

Predictions are presented of correlations in rapidity and in scaled longitudinal momentum (Feynman x/sub F/) for associated production of a bottom quark b and its antiquark in high-energy fixed-target and collider experiments. Rapidity correlations are positive but remarkably broad in the central region at current collider energies, extending a factor of 2 beyond the ~2 units typical of short-range order.

28542 Charm and the rise of the pp-bar total cross section. Jones, S.T.; Dash, J.W. (Department of Physics and Astronomy, The University of Alabama, Tuscaloosa, Alabama 35487). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 7, 1818-1823(1 Apr 1988).

We give a detailed description of the pp-bar forward amplitude through CERN SPS collider energies, using the flavored Pomeron model as an effective parametrization of nonperturbative QCD. We show that the rise in the total cross section between CERN ISR and SPS collider energies is consistent with the onset of charmed-particle production up to the level of a few millibarns, along with other processes, and in agreement with available data. In contrast with our estimates of charm production, perturbative QCD charm-production calculations are well below the data. We give estimates of the p-bar and K/sup +- / multiplicities at SPS collider energies. We also present a simplified version of the flavoring model in order to facilitate comparisons between it and other parametrizations.

28543 Transformation of neutron polarization in polarized media and tests of T invariance. Kabir, P.K. (Research Institute for Theoretical Physics, University of Helsinki, Helsinki, Finland). *Physical Review [Section] D: Particles and Fields;* **37**: No. 7, 1856-1859(1 Apr 1988).

A general analysis is given for the modification of neutron polarization resulting from passage through a polarized medium. The previously proposed search for precession (properly defined) of neutron spin about k x S remains a valid test of T invariance in the presence of other spin-dependent interactions which cause further changes. However, as noted by Bunakov and Gudkov, the development of transverse polarization along this direction is not an absolute test, but, if such polarization is found, the measurement of corresponding asymmetry in the transmission of polarized neutrons is shown to furnish an unambiguous test. A complete set of such tests is given.

28544 Do data on W and Z decays already constrain nonstandard physics?. Datta, A.; Drees, M.; Godbole, R.M.; Tata, X.R. (Institute fuer Physik, Universitaet, Dortmund, 4600 Dortmund 50, West Germany). *Physical Review [Section] D: Particles and Fields;* **37**: No. 7, 1876-1891(1 Apr 1988).

We study the predictions of several extensions of the standard model (SM) for the ratio R = N(pp-bar→W→eν)/N(pp-bar→Z→e^+e^-). The starting point of our investigation is the observation that the SM prediction for R seems to be somewhat above the data, especially if the top quark is heavy. We first show that this situation is not changed qualitatively by the incorporation of full quark-mass-dependent QCD corrections for Γ/sub W/ and Γ/sub Z/. However, if either gauginos or exotic E(6) leptons with suitably chosen masses and mixings are present, the prediction for R can be reduced by 0.5—0.7 units. A similar reduction is possible if the Z boson mixes with the Z' boson present in certain SO(10) and E(6) models. For large top masses the reduction of R can be even larger if the b quark has a sizable SU(2)-singlet component, which is possible in superstring-inspired E(6) models. However, sleptons or squarks cannot reduce the prediction for R, and in models with two Higgs doublets R is expected to be close to its SM value. We then show that existing data strongly disfavor a sequential down-type quark below 26 GeV, and derive limits on the V/sub t//sub b/ element of the extended Kobayashi-Maskawa mixing matrix of four-generation models. We also show that the data on R together with existing bounds on the rho parameter severely constrain models of four-generation quark mass matrices.

28545 On the Wilson coefficient of the penguin operator. Cheng, H. (Physics Department, Indiana University, Bloomington, Indiana 47405). *Physical Review [Section] D: Particles and Fields;* **37**: No. 7, 1908-1911(1 Apr 1988).

Recently an additional contribution to the real part of the Wilson coefficient function c_8 of the dominant penguin operator O_8 in K→2π decay was found by Bardeen, Buras, and Gerard. We show that in the effective-Hamiltonian approach used by Gilman and Wise with the "heavy"-charm-quark approximation, the additional contribution to c_8 originates from the penguin diagrams with u-quark loops which are left after the charm quark is integrated out. For μ∼1 GeV (μ being the renormalization scale), the inclusion of the u-quark loop diagram amounts to adding a contribution $(5/3\alpha_s(\mu)/12\pi$ to the standard estimate of c_8. Penguin diagrams at the low-momentum scale are briefly discussed.

28546 Dirac quantization of πrhoω solitons. Lee, S.H.; Zahed, I. (Physics Department, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review [Section] D: Particles and Fields;* **37**: No. 7, 1963-1970(1 Apr 1988).

The local U(1)/sub Y/xSU(2)/sub V/ version of the Skyrme model with minimal breaking is quantized using Dirac's method. After removing the spurious spin-isospin zero modes from the meson spectrum, a pertinent meson-nucleon Hamiltonian is constructed. In the strong ω-coupling limit the semiclassical results for the nucleon and Δ isobar are recovered. The nonperturbative mesonic content of the nucleon is discussed. The concept of vector dominance is used to justify the local vector approach.

28547 Chiral nontopological solitons with perturbative quantum pions. Williams, A.G.; Dodd, L.R. (Institute for Nuclear Theory, Department of Physics, FM-15, University of Washington, Seattle, Washington 98195). *Physical Review [Section] D: Particles and Fields;* **37**: No. 7, 1971-1981(1 Apr 1988).

We investigate chiral extensions of a broad class of nontopological soliton bag models. Chiral symmetry is restored in a nonlinear realization through the introduction of an elementary pion field. We show in particular that it is consistent to treat the pions as a perturbative quantum field, as is done in the cloudy-bag model. The cloudy-bag model is recovered as a limiting case. A careful comparison is made between predictions of chiral extensions of the Friedberg-Lee and the Nielsen-Patkos color-dielectric nontopological soliton models and the cloudy-bag model. Once the overall distance scale is fixed we find relative insensitivity to the detailed choice of nontopological soliton parameters. We investigate two versions of chiral nontopological solitons, analogous to the surface- and volume-coupled cloudy-bag model, and discuss their relation to current algebra.

28548 Implications of the decay D/sub s/→$\pi^+\pi^-\pi^+$. Suzuki, M. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* **37**: No. 7, 2009-2011(1 Apr 1988). Contract AC03-76SF00098.

The recently observed decay mode D/sub s/→$\pi^+\pi^-\pi^+$ is studied by incorporating chiral dynamics for the final pions and the experimental observation that the Dalitz plot of $\pi^+\pi^-\pi^+$ is approximately flat. The sum of the D/sub s/→5π decay rates is vanishingly small and the decays into even-number pions are all forbidden. We propose a speculative resonance model to explain the large rate for D/sub s/→$\pi^+\pi^-\pi^+$ and the absence of D/sub s/→rhoπ. .AE

28549 QCD coherence in high-energy reactions. Dokshitzer, Y.L.; Khoze, V.A.; Troyan, S.I.; Mueller, A.H. (Academy of Sciences of the Union of Soviet Socialist Republics, Leningrad Nuclear Physics Institute, SU-188350 Gatchina, Leningrad District, Union of Soviet Socialist Republics). *Reviews of Modern Physics;* **60**: No. 2, 373-388(Apr 1988).

The authors review the ideas and manifestations of QCD coherence in high-energy reactions producing jets. They suggest experiments involving two-jet production, high-p/sub perpendicular/ γ production and high-p/sub perpendicular/W production at hadronic colliders as ways to see QCD coherence in stringlike effects. They also suggest a procedure for finding the dip in the inclusive hadron spectrum of jets for those jets produced at hadron colliders. Simple explanations of the various coherence effects in QCD are discussed, as is the idea of local parton-hadron duality.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 28537, 28543, 28559, 28565

28550 (IC—87/66) On the classical mechanics of a nonrelativistic superparticle. Aneva, B.; Boshilov, P.; Stoyanov, D. (International Centre for Theoretical Physics, Trieste (Italy); Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702237/JAW.

A classical Lagrangian function for a system with even and odd degrees of freedom is proposed and studied. The quantization is performed without the appearance of non-trivial constraints and it leads to the previously defined supersymmetric Schroedinger equation. (author). 5 refs.

28551 (IFT-P—34/87) Integrability and symmetric spaces. I- The Group Manifold. Ferreira, L.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702265/JAW.

It is shown that any non singular lagrangian describing the motion of a particle on a semisimple Lie group possesses a Fundamental Poisson bracket relation (FPR) and consequently charges in involution. (autor).

28552 (IFT-P—35/87) Integrability and symmetric spaces. II- The coset spaces. Ferreira, L.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702266/JAW.

It shown that a sufficient condition for a model describing the motion of a particle on a coset space to possess a fundamental Poisson bracket relation, and consequently charges involution, is that it must be a symmetric space. The conditions a hamiltonian, or any function of the canonical variables, has to satisfy in order to commute with these charges are studied. It is shown that, for the case of non compact symmetric space, these conditions lead to an algebraic structure which plays an important role in the construction of conserved quantities.

28553 (ITP—86-167) Chiral symmetry breaking in asymptotically free and non-asymptotically free gauge theories. Gusynin, V.P.; Miranskij, V.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702421/JAW.

An essential distinction in the realization of the PCAC-dynamics in vector-like asymptotically free and non-asymptotically free (with a non-trival ultraviolet stable fixed point) gauge theories is revealed. For the latter theories an analytical expression for the condensate <psi-barpsi> is obtained in the two-loop approximation and the arguments in support of a soft behaviour at small distances of composite operators are given. The problem of factorizing the low-energy region for the Wess-Zumino-Witten action is discussed. 14 refs.

28554 (JINR-R—2-87-426) Cohomology operators on superstring differential forms. Dao Vong Duk; Nguyen Thi Hong. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702444/JAW.

The explicit formulae are derived for cohomology operators on superstring differential forms of arbitrary order. These formulae are used for the study of the gauge invariance of equations of the string field functionals. Various identities for the structure constants of the associated superalgebras are also given. 15 refs.

28555 (NORDITA—87/67-P(prepr.)) Higher symmetries in c=1 conformally invariant systems. Baake, M.; Rittenberg, V.; Christe, P. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Bonn Univ. (Germany, F.R.). Physikalisches Inst.). 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753287/JAW.

The operator contents of the XXZ and D/sub n/ symmetric models depend on one parameter which is related to the compactification radius of the bosonic string. It is shown that for rational values of this parameter the symmetry can be described by a family of algebras labelled by the ratio p/r of two coprime integers.

28556 (NORDITA—87/68-P(prepr.)) Superconformal Ward identities and the supertorus. Grundberg, J.; Nakayama, R. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Dec 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753288/JAW.

We derive superconformal Ward identities in the context of superspace supergravity. From these Ward identities we extract operator product expansions and the case of a supertorus is studied in some detail.

28557 Boundary conditions and renormalization in anti—de Sitter supersymmetry. Bellucci, S.; Gonzalez, J. (Istituto Nazionale di Fisica Nucleare, Laboratori Nazionali di Frascati, Casella Postale 13, 00044 Frascati (Roma), Italy). *Physical Review [Section] D: Particles and Fields;* **37**: No. 8, 2357-2360(15 Apr 1988).

We show that the expansion in powers of the contraction parameter of anti—de Sitter space of the exact scalar and spinor propagators reproduces the standard adiabatic expansion up to an order beyond which no contribution to divergent counterterms can be expected, dismissing the claim about the role played by boundary conditions in the renormalization of supersymmetric models.

28558 Constraints from the Drell-Hearn-Gerasimov sum rule in chiral models of composite fermions. Jaffe, R.L.; Ryzak, Z. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **37**: No. 7, 2015-2018(1 Apr 1988).

We analyze a dispersion relation for a spin-flip Compton amplitude in a chiral model of composite quarks and leptons. We discuss the asymptotic behavior of the amplitude and show under what conditions the Drell-Hearn-Gerasimov sum rule holds. Using a small-mass expansion we derive a consistency condition that relates the photoproduction cross sections for different helicities. We show that this condition suggests the existence of higher-spin excited fermions, as well as relations among a priori independent photoproduction amplitudes.

6454 Field Theory

REFER ALSO TO CITATION(S) 28341, 28540, 28557, 28558, 28725

28559 (CBPF-NF—058/87) Operator content of the n-states quantum chains in the c=1 region. Gehlen, G. von; Schuetz, G.; Rittenberg, V. (Bonn Univ. (Germany, F.R.)). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702221/JAW.

We conjecture the operator content for the n-states quantum chains ($n \geq 5$) in the domains of the coupling constants where the central charge of the Virasoro algebra is iqual to one. Free boundary conditions as well as boundary conditions compatible with the torus are considered. The conjectured operator content is compared with finite-size scaling estimates.

28560 (CBPF-NF—059/87) Gap road to chaos: Liapunov and uncertainty exponents and multifractality. Sousa Vieira, M. da C. de; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702222/JAW.

We study the prototype of the gap road to chaos, namely X/sub t+1/= 1- ϵ/sub i/ - a]X/sub t/]/sup z//sub i/ (i=1,2 respectively correspond to $x \geq 0$ and $x<0$; ϵ /sub 1/ not = ϵ /sub 2/). Intriguing properties are observed concerning the (a, ϵ /sub 1/, ϵ/sub 2/)- evolution of the attractors and the Liapunov and uncertainty exponents; also, multifractality is exhibited at the first entrance to chaos.

28561 (CBPF-NF—060/87) On the quantization of constrained generalized dynamics. Galvao, C.A.P.; Lemos, N.A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702223/JAW.

A special class of degenerate second order Lagrangians, those which differ from a nondegenerate first order Lagrangian by a total time derivative (or a four divergence) of a function of both the coordinates and velocities, is studied in detail. The canonical quantization of such systems is then realized and it is shown that this leads to the same results as in the first order Lagrangian. (M.W.O.).

28562 (IC—87/68) Superalgebras with Grassmann algebra-valued structure constants from superfields. Azcarraga, J.A. de; Lukierski, J. (Valencia Univ. (Spain). Dept. de Fisica Teorica). (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702239/JAW.

We introduce generalized Lie algebras and superalgebras with generators and structure constants taking values in a Grassmann algebra. Such algebraic structures describe the equal time algebras in the superfield formalism. As an example we consider the equal time commutators and anticommutators among bilinears made out of the D=1 quantum superfields describing the supersymmetric harmonic oscillator. (author). 10 refs.

28563 (IC—87/70) Relation between Polyakov's and Fradkin's path integrals for bosonic string. Jaskolski, Z.; Rytel, L.; Klimek, M. (International Centre for Theoretical Physics, Trieste (Italy); Czestochowa Technical Univ. (Poland)). (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702241/JAW.

The relation between Polyakov's path integral and Fradkin's integral in extended phase space is analyzed on an example of a free closed bosonic string. It is shown in D=26 that locally, in every Teichmueller sector, both methods provide the same result. Beyond D=26 Fradkin's integral appears to be depending on the gauge fixing. (author). 12 refs.

28564 (IC—87/71) Quantization of Green-Schwarz superstring. Kallosh, R.E. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702242/JAW.

The problem of quantization of superstrings is traced back to the nil-potency of gauge generators of the first-generation ghosts. The quantization of such theories is performed. The novel feature of this quantization is the freedom in choosing the number of ghost generations as well as gauge conditions. As an example, we perform quantization of heterotic string in a gauge, which preserves space-time supersymmetry. The equations of motion are those of a free theory. (author). 12 refs, 2 figs.

28565 (IC—87/221) HyperKahler properties of hypermultiplet theory. El Hassouni, A.; Lhallabi, T.; Saidi, E.H.; Oudrhiri-Safiani, E.G. (International Centre for Theoretical Physics, Trieste (Italy); Laboratoire de Physique Theorique, Rabat (Morocco). Faculte des Sciences). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702249/JAW.

We study the Galperin et al. model in the presence of central charges. We give a large class of solutions of the auxiliary field equations of motion parametrized by a pure gauge degree of freedom ω. The latter can be eliminated through a gauge fixing condition. The generalized hyper-Kahler metric is worked out and the corresponding Kahler-like potentials are derived. A generalization of the model to a non-Abelian global group is given. Then, we examine the coupling of the model to the N=2 gauge multiplet. We show that the gauge symmetry is never broken and as a consequence, the gauged model is completely integrable with respect to the harmonic variables. The extra degree of freedom ω and the scalar potential of the model are discussed. (author). 14 refs.

28566 (INIS-mf—11653) Lattice analysis of SU(2) chromodynamics with light quarks. Laermann, E. (Technische Hochschule Aachen (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 27 Jan 1986. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753255/JAW.

I report on the Monte-Carlo simulation of a SU(2) lattice gauge theory which includes dynamical Kogut-Susskind quarks. On a 16*8/sup 3/ lattice the masses of rho and π mesons are studied, the condensate <anti phiphi> measuring the chiral symmetry breaking determined, and the potential between static quarks measured. Extrapolations to vanishing quark mass yield a finite rho mass but a value for the π mass which is compatible with zero, as well as a result different from zero for the quark condensate in accordance with the spontaneous breaking of the chiral symmetry of massless non-Abelian gauge theories. The shape of the q-anti q potential equals the pure gauge potential for small to intermediate distances. However at large distances (σ(fm)) deviations from the linear increase are indicated as they are expected due to the breakup of the flux tube between heavy quarks because of spontaneous quark-pair production. For all numerical calculations it is common that they favor a value for the scale parameter Asub(anti Manti S)(N/sub F/=4) of quantum chromodynamics which is smaller than in the pure gauge field theory.

28567 (ITEP—107(1987)) Geometry of superconformal manifolds. Part 1. Roslyi, A.A.; Schwarz, A.S.; Voronov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702405/JAW.

The main facts about complex curves are generalized to superconformal manifolds. The results thus obtained are relevant to the dermion string theory and, in particular, they are useful for computation of determinants of superlaplacians which enter the string partition function. 13 refs.

28568 (ITEP—115(1987)) Geometry of superconformal manifolds. Part 2. Roslyi, A.A.; Schwarz, A.S.; Voronov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702406/JAW.

The study of superconfirmal manifolds is continued. The cohomologies of such manifolds with coefficients in a holomorphic line bundle are investigated. 6 refs.

28569 (ITP—86-112) Thermal properties of QED/sub 3/ and confinement. Novikov, M.Yu.; Shelest, V.P.; Sorin, A.S.; Tsejtlin, V.Yu. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702417/JAW.

Thermal properties of quantum electrodynamics in 2+1 dimensions are studied. The systematic account of screening in the framework of the skeleton perturbation theory removes the infrared divergencies of thermodynamic quantities and leads to the non-analytically of the type g/sup 2/lng/sup 2/. The polarizaion tensor, the thermodynamic potential and the fermion self-energy are investigated and the results obtained are used to discuss the possible absence of deconfinement in the model. 17 refs.

28570 (JINR-E—2-87-390) Theories with higher derivatives and gauge-transformation construction. Gogilidze, S.A.; Sanadze, V.V.; Trebuchava, F.G.; Surovtsev, Yu.S. (Tbilisskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702432/JAW.

The way of construction of infinitesimal gauge transformations for a given singular Lagrangian, including Lagrangians with higher-order derivations, is dicussed. The construction is first made in the space with the use of an extended Hamilton formalism, and then the corresponding transformations are constructed in a tangent bundle. Examples are analysed. 14 refs.

28571 (JINR-R—2-87-331) Symmetry problem of energy-momentum tensor and the creation of gravitational field. Dubets, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702442/JAW.

The problem of symmetry of energy-momentum tensor (EMT) of electromagnetic field in medium is considered as a general problem of Lagrange formalism with external fields. It is shown, that the asymmetrical Minkowski EMT correctly describes the

system of field and medium, being the result of "symmetrization" of canonical EMT. But a symmetrical, conserving source of gravitational field is needed, while the symmetrical Hilbert EMT, which should be used in this role, is not conserved. So a formal method of obtaining such a source is proposed. 10 refs.

28572 **(JINR-R—4-87-422) Charge form factors of nonstrange dibaryons in SU(2) Skyrme model.** Nikolaev, V.A.; Tkachev, O.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Dal'nevostochnyj Gosudarstvennyj Univ., Vladivostok (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702451/JAW.

The electric charge density and form factors are calculated for nonstrange dibaryons in SU(2) Skyrme model. The dibaryon under consideration corresponds to the anzats where the additional winding number of the fields is obtained by dubling the twist in the isovector fields rather than in the chiral angle. The obtained form factors are compared with those from the relativistic harmonic oscillator model for the six quark system. 7 refs.; 4 figs.

28573 **(JINR-R—5-87-572) On the stability of Kink-solutions for a nonlinear Klein-Gordon equation.** Zhidkov, P.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702455/JAW.

The stability in the special sense of the kink-solutions for the complex Klein-Gordon equation and the "form stability" of the kink-solutions for the real Klein-Gordon equation are proved. The ideas of the Benjamin method are developed which are based on proving the positiveness of the second variation of the conservation law of the system under conditions on a class of admissible functions. 11 refs.

28574 **(NBI-HE—87-70) Toroidal compactification of open and closed bosonic strings.** Dunbar, D.C. (Niels Bohr Inst., Copenhagen (Denmark)). Nov 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753278/JAW.

Using the duality transformation between open string loops and closed string exchanges the known compactifications of the closed bosonic string on tori described by even self-dual lattices are coupled to similarly compactified open strings.

28575 **(NBI-HE—87-71) Coupling of open to closed bosonic strings in four dimensions.** Bern, Z.; Dunbar, D.C. (Niels Bohr Inst., Copenhagen (Denmark)). Nov 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753279/JAW.

We study the construction of $D < 26$ open bosonic string theories using the fermionic formulation for the internal degrees of freedom. The various models are specified by the boundary conditions of the world sheet fermions on the annulus. Using the fact that open string loops can be transformed into closed string exchanges, we determine possible open string models which may be coupled to known $D < 26$ closed string models. Finally, as a verification of consistency, we examine particular open string non-planar amplitudes.

28576 **Calculating the effective action for a self-interacting scalar quantum field theory in a curved background spacetime.** Guven, J. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 8, 2182-2195(15 Apr 1988).

We obtain an expansion in derivatives for the effective action of a self-interacting scalar field theory in a curved background spacetime. Working within the DeWitt—Schwinger proper-time representation, we first present a generalization of the recursive method introduced by DeWitt to obtain the proper-time series. We then provide an alternative path-integral derivation using Riemann normal coordinates. We conclude with an examination of the breakdown of the expansion in derivatives when the mass scale vanishes. We argue that the massless limit necessarily leads to nonlocal behavior. To illustrate this, we employ a second-order quasilocal approximation and reexamine perturbation theory within the proper-time framework.

28577 **Functional representation for fermionic quantum fields.** Floreanini, R.; Jackiw, R. (Center for Theoretical Physics, Laboratory for Nuclear Science Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 8, 2206-2224(15 Apr 1988).

A functional representation for fermionic quantum fields is developed in analogy to familiar results for bosonic fields. The infinite Clifford algebra of the field anticommutator is realized reducibly on a Grassmann functional space. On this space, transformation groups may be represented without normal ordering with respect to a Fock vacuum, and a projective representation for the two-dimensional conformal group is found, which is compared to the corresponding representation in terms of bosonic fields. When a quadratic Hamiltonian for the Fermi fields is posited, a Fock space can be constructed after a prescription for filling the Dirac sea is selected. Different filling prescriptions lead to inequivalent Fock spaces within the functional space. Explicit eigenfunctionals exhibit the peculiarities of fermionic field theory, such as fractional charge, Berry's phase, and anomalies.

28578 **Decompositions of representations of exceptional affine algebras with respect to conformal subalgebras.** Kac, V.G.; Sanielevici, M.N. (Department of Mathematics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 8, 2231-2237(15 Apr 1988).

We use modular-invariance and conformal-invariance constraints on the highest-weight representations of affine algebras as well as asymptotic behavior of their characters to deduce an algorithm for the decomposition of these representations with respect to conformal subalgebras. We use the algorithm to find explicit decompositions of level-1 representations of all affine exceptional algebras with respect to all their conformal subalgebras. The crucial point of this work is a connection of the decomposition problem with the Frobenius theory of positive matrices, which hints to a possible connection with Markov chains. The problem of computing branching coefficients for conformal subalgebras arises in the string compactifications. We show that a solution to this problem allows one to construct modular-invariant partition functions on a group manifold. An important new general theoretical result of the paper is the uniqueness of the vacuum state in the basic representation of an affine algebra for its conformal subalgebra.

28579 **Semiclassical analysis of the weak-coupling limit of SU(2) lattice gauge theory: The subspace of constant fields.** Bartels, J.; Wu, T.T. (II. Institut fuer Theoretische Physik, Universitaet Hamburg, Hamburg, West Germany). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 8, 2307-2318(15 Apr 1988).

This paper contains the first part of a systematic semiclassical analysis of the weak-coupling limit of lattice gauge theories, using the Hamiltonian formulation. The model consists of an N^3 cubic lattice of pure SU(2) Yang-Mills theory, and in this first part we limit ourselves to the subspace of constant field configurations. We investigate the flow of classical trajectories, with a particular emphasis on the existence and location of caustics. There the ground-state wave function is expected to peak. It is found that regions densely filled with caustics are very close to the origin, i.e., in the domain of weak field configurations. This strongly supports the expectation that caustics are essential for quantities of physical interest.

28580 **Flow-gauge Slavnov-Taylor identities for Zwanziger's gauge fixing.** Alvarez-Estrada, R.F.; Munoz Sudupe, A. (Departamento de Fisica Teorica, Universidad Complutense, Madrid 28040, Spain). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 8, 2340-2343(15 Apr 1988).

The generalization of the Slavnov-Taylor identities for the stochastically quantized Yang-Mills field theory with either Zwan-

ziger gauge fixing or, equivalently, Faddeev-Popov flow-gauge fixing in one higher dimension is presented. Those exact relationships among Green's functions in the stochastically quantized theory are derived by extending suitably Slavnov's method. As a consequence there is no renormalization of the longitudinal part of Green's functions in $\alpha = 0$, to all perturbative orders. Based on the general identities, the divergent longitudinal part of the two-point Green's function is calculated to second order for $\alpha = 1$, and it is found to agree with other independent calculations.

28581 Comment on a paper by Pauli and Brodsky. Hagen, C.R. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review [Section] D: Particles and Fields;* 37: No. 8, 2362-2362(15 Apr 1988).

It is noted that a recent work by Pauli and Brodsky is in conflict with theorems obtained by the author which demonstrate that light-cone field theories lack both covariance and a conserved charged operator.

65 PHYSICS II

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 28632, 28633, 28634

28582 (BNL-NCS—40821) Reference nuclear data for space applications. Pearlstein, S. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-8711149—2).

From Conference on high energy radiation background in space; Sanibel Island, FL, USA (3 Nov 1987).

The National Nuclear Data Center (NNDC) at Brookhaven National Laboratory is active in the development of high energy data bases for space applications. Validated data and methods of interaction analysis are needed to explain and predict radiation patterns. The NNDC uses methods consisting of nuclear systematics and nuclear model codes to provide neutron and proton induced reaction data from 1 MeV and 1 GeV. The data can placed in convenient form for use by radiation transport codes. In addition to cross-sections, nuclear structure and radioactive decay data are also stored in data bases. Data are distributed by the NNDC in a variety of ways including on-line access through computer networks or telephone lines. 7 refs., 7 figs.

28583 (INIS-mf—11163) Progress report 1984. (Alberta Univ., Edmonton (Canada). Dept. of Physics). 1984. 157p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702343/JAW.

Developments in electronics included a hall probe for the TRIUMF facility, a wire chamber delay line amplifier, filter boards, NMR, photomultiplier headers, LED pulsers, wire chambers, and a digital signal amplifier. In addition to their involvement in the TRIUMF experimental program, University of Alberta personnel are involved with the operation and design of primary beamlines and secondary channels. Recent projects included medium resolution spectrometer upgrade and twister, the production of complete longitudinal polarization, the M11 pion channel, kaon factory studies, and beam transport improvements. The current experimental program includes work on n-p, p + /sup 16/O, and p-p scattering, radiative polarized neutron capture, and proton-proton bremsstrahlung. Theoretical studies and the future research program are also outlined.

28584 (INIS-mf—11164) Progress report 1983. (Alberta Univ., Edmonton (Canada). Dept. of Physics). 1983. 105p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702344/JAW.

After a brief description of the operation of the van de Graaf accelerator and other facilities, this report summarizes the principal research programs and the Nuclear Research Centre. These include studies of the D(n,2n)p reaction, external beam PIXE work, investigations of the level structure of /sup 146/Nd, studies of the nuclear structure of /sup 49/V, neutron-nucleus scattering, and isospin dependence in the volume integral of the central real part of the optical model potential.

28585 (ITEP—8(1987)) Mass yield distributions for the reactions Ca+Ca, Nb+Nb and Ca+Ca at E/A=800 MeV in the molecular-dynamical model. Kiselev, S.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702402/JAW.

Mass yield distributions obtained on the basis of the molecular-dynamical model are presented for the Ca+Ca, Nb+Nb reactions at E/A=400 MeV and Ca+Ca reaction at E/A=800 MeV. For the fragments with masses upto quarter of the mass of initial nucleus the model predicts a power law for mass spectra with almost the same value of the exponent. Such the behaviour is roughly a result of the superposition of the fireball breakup and the disintegration of spectator regions rather than the evidence of a liquid-gas-like phase transition in hot nuclear matter. 13 refs.; 2 figs.; 1 tab.

28586 (JINR-E—1-87-337) Observation of /sup 4//sub Λ/H relativistic hypernuclei produced in /sup 4/He collisions with light nuclei at 18 GeV/c. Avramenko, S.A.; Aksinenko, V.D.; Butenko, V.A. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702430/JAW.

Preliminary results of a search for hypernuclei produced in relativistic heavy ion beams are presented. Two reactions have been studied: /sup 7/Li+CH/sub 2/ -> /sub Λ//sup 7/Li+X at 3.0 GeV per nucleon with a consequent decay /sub Λ//sup 7/Li -> π/sup -/ +/sup 7/Be and /sup 4/He+CH/sub 2/ -> /sub Λ//sup 4/H+X at 3.7 GeV per nucleon with a consequent decay /sup 4/H/sub Λ/ -> π/sup -/+/sup 4/He. Available statistics has resulted in five registered /sub Λ//sup 7/Li decay. Accordingly, the cross section of /sub Λ//sup 4/H production is about 0.2 microbarns (~ 0.02 mcb per target nucleon) and the upper limit of the cross section of /sub Λ//sup 7/Li production is about 1 mcb (~ 0.1 mcb per target nucleon). The /sub Λ//sup 4/H mean-life has been estimated to be tau = (3.3/sub -1.2//sup +2.3/)x10/sup -10/ s. 9 refs.; 1 tab.; 2 figs.

28587 Remarks about fields of high intensity. Teller, E. (Lawrence Livermore National Lab., CA (USA)). pp 1-2 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

At high field strength any known material will break down by the production of electrons and ions. At a higher field strength, massive production of pairs will occur. This phenomenon is discussed when heavy ions of $\gamma \approx 100$ collide. Even when the heavy ions approach to within one nuclear radius, pair production involving electrons and mesons must be expected. High magnetic fields between the nuclei might be coupled to pairs of magnetic monopoles.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

28588 (INIS-mf—11652) Measurement of the EMC effect on nuclei with different mass number. Dueren, M. (Technische Hochschule Aachen (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 27 Nov 1987. 184p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753254/JAW.

In the present thesis the analysis of the NA2' experiment of the European Muon Collaboration was treated. The result is the measurement of the EMC effect on deuterium, carbon, copper, and tin with low statistical and systematic errors. The experiment was after the discovery of the EMC effect in the year 1983 concepted just for this purpose. By an able target construction and by the periodic exchange of the different targets it could be reached that the geometrical acceptances of the experiment were identical for

the different targets and that by this scarcely corrections for the measured event rates resulted. The most important physical correction of the raw data was the electromagnetic radiative correction which was performed with special regards to the nuclear effects. A manifold of systematic studies was performed in order to confirm the measurements results and to facilitate an estimation of systematic errors. (orig./HSI).

28589 (ITEP—63(1987)) Description of the three-nucleon system in the quark compound bag method and the vertex function for the decay /sup 3/He->pd. Grach, I.L.; Kalashnikova, Yu.S.; Narodetskij, I.M.; Yurov, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702403/JAW.

The model of NN potential derived in the Quark Compound Bag(QCB) method is used to calculate the vertex function G(p/sup 2/) for the virtual decay /sup 3/He -> pd. It is shown that even in its simplest version the QCB method provides a realistic description of G(p/sup 2/) which agree with the latest experimental data. The effects of the six quark bag corrections to G(p/sup 2/) at <or approx. 100 MeV/c do not exceed 2%. 8 refs.; 1 fig.

28590 (JINR-R—1-87-340) Determination of the topological cross sections in dd interactions at 12 GeV/c. Batyunya, B.V.; Boguslavskij, I.V.; Bruntsko, D. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702438/JAW.

The topological cross sections, mean multiplicity and dispersion of multiplicity distribution of charged secondaries in inelastic dd interactions at 12 GeV/c on a statistics of ~ 27000 events are determined. The methodical problem connected with the separartion of inealstic dd interactions with different numbers of secondary charged particles. 9 refs.; 5 figs.; 4 tabs.

28591 Measurement of the gravitational acceleration of the antiproton: an experimental overview. Jarmie, N. (Los Alamos National Lab., NM (USA)). pp 437-441 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract W-7405-ENG-36.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An ambitious experiment is being developed to measure the force of the antiproton due to the gravitational field of the earth. The technique consists in obtaining antiprotons of the lowest energy possible from the LEAR facility at CERN, decelerating them further in an external beam line, trapping and cooling them to ultralow energy, and measuring their gravitational acceleration by time-of-flight methods. The experiment has been granted CERN approval (PS-200). Present plans and initial development efforts are described.

28592 Considerations for electromagnetic antiproton traps. Kenefick, R.A. (Texas A & M Univ., College Station (USA)). pp 442-446 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The selection of a Penning ion trap as the capture, storage and launching device for an experiment which will attempt to detect and quantitatively measure the gravitational acceleration of antiprotons is described. Effects due to trap physical parameters, residual vacuum, and rf interrogation of the trapped particle ensemble are considered. Techniques for cooling the trapped particles from approximately 100 eV to near 4 K are discussed. Recent work towards realization of the system is reported.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

28593 (INIS-mf—11209) Electron-scattering study of /sup 15/N. Vries, J.W. de. (Rijksuniversiteit Utrecht (Netherlands)). 9 Dec 1987. 83p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702386/JAW.

Contains summmary in Dutch.

An electron scattering experiment on /sup 15/N was performed in order to test the results of two different shell-model approaches, both performed in a full (0+2)Planck constantω space, one employing a phenomenologic interaction which is valid throughout the 1p shell, the other an interaction whose parameters were adjusted to fit the excitation energies of a number of states. The experiment was carried out at the high-energy electron-scattering facility of NIKHEF-k. A room temperature gas target was employed. Data were taken at forward angles in the range q=0.35 - 3.17 fm/sup -1/. Results are presented for negative-parity states up to an excitation energy of 13 MeV. The differences in groundstate charge density between /sup 15/N and the neighbouring nuclei / sup 16/O and /sup 14/N are compared with results of shell-model calculations. In ch. 5 the transition charge-densities to the excited negative-parity states are presented and compared with shell model calculations. 52 refs.; 18 figs.; 5 tabs.

28594 Pion inelastic scattering to the three lowest 2^+ states of /sup 18/O. Seestrom-Morris, S.J.; Dehnhard, D.; Franey, M.A.; Holtkamp, D.B.; Blilie, C.L.; Morris, C.L.; Zumbro, J.D.; Fortune, H.T. (University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 2057-2063(May 1988).

Angular distributions were measured for excitation of the 2_1^+(1.98), 2_2^+(3.92), and 2_3^+(5.26) states of /sup 18/O by π^+ and π^- scattering at T/sub π/ = 164 MeV. The data have been compared with distorted-wave impulse-approximation calculations using transition densities from the collective model, from electron scattering, and from the coexistence model. The calculations using (e,e') transition densities reproduce the shapes of the angular distributions very well and the magnitudes of the cross sections to within 15%. The collective-model transition densities fail to fit the data unless the radius is adjusted from the ground-state value.

28595 Reaction (π/sup +/,π/sup +/d) on /sup 6/Li and /sup 12/C. Hurd, J.R.; Boswell, J.S.; Minehart, R.C.; Tzeng, Y.; Ziock, H.J.; Ziock, K.O.H.; Liu, L.C.; Siciliano, E.R. (Virginia Univ., Charlottesville (USA). Dept. of Physics; Los Alamos National Lab., NM (USA); Georgia Univ., Athens (USA). Dept. of Physics and Astronomy). *Nuclear Physics [Section] A;* **475**: No. 4, 743-760(28 Dec 1987).

We have measured the angular and momentum distributions of the scattered pions from the reactions /sup 6/Li(π/sup +/,π/sup +/d)/sup 4/He and /sup 12/C(π/sup +/,π/sup +/d)/sup 10/B in a coincidence experiment. We compare our results with two models based on the impulse approximation: a 'one-step model' in which it is assumed that a pair of nucleons with a close spatial correlation is ejected simultaneously, and a 'two-step model' in which it is assumed that the incident pion interacts with a single nucleon which then picks up a second nucleon of appropriate charge to form a deuteron. In the case of /sup 6/Li both models give almost identical results and describe the shapes of the measured angular and momentum distributions well. In the case of /sup 12/C the two-step model agrees more nearly with the experimental results.

28596 Crystal blocking in heavy ion reactions. Gomez del Campo, J. (Oak Ridge National Lab., TN (USA)). pp 447-453 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The crystal blocking technique for measuring short lifetimes (10^{-18} s) was developed during the 1960s from the study of the channeling effect. Early blocking lifetime measurements involved

light ion resonance reactions yielding typical lifetime values of order of 10^{-17} s. Recently, studies on heavy-ion induced fission and fusion have extended the technique into the 10^{-18} to 10^{-19} s scale. In this work measurements of fusion for ^{16}O + Ge are presented for bombarding energies around 8 MeV/nucleon. Also measurements of the projectile fragmentation of 44 MeV/nucleon ^{40}Ar + Ge are discussed. In all reactions studied the presence of particle evaporation is the dominant mechanism that determines the reaction times of ~ 10^{-18} s measured with the blocking technique.

28597 **^{13}N level structure via the $^{10}B(^3He, ^3He)$ elastic scattering.** Barhoumi, S.; Allab, M.; Beaumevieille, H.; Chami, A.C.; Meliani, Z. (USTHB, Alger (Algeria)). pp 477-479 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The (^3He, ^3He) elastic scattering cross-sections on ^{10}B have been measured at E(^3He) = 1.5-3.3 MeV and for centre-of-mass angles theta/sub cm/ = 75.1°, 107.5° and 143.3°. Two complete angular distributions were measured at E(^3He) = 2.10 and 2.98 MeV. Scattering anomalies were observed at bombarding energies of 2.10, 2.90 and 2.975 MeV corresponding to excited states in ^{13}N at 23.25, 23.87 and 23.93 MeV. Resonances were analyzed using a R-Matrix approximation, and level parameters have been extracted.

28598 **Radioactive ion beam research at Lawrence Livermore National Laboratory.** Sale, K.E.; Bauer, R.W.; Boyd, R.N.; Mathews, G.J.; Haight, R.C.; Corn, P.B. (Lawrence Livermore National Lab., CA (USA)). pp 490-492 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1). Contract W-7405-ENG-48.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Several modifications and additions have been made to improve the radioactive beam facility at Livermore [1] with the main aim of measuring the cross section for $^7Be(p, \gamma)^8B$ (which is important in determining the solar neutrino flux) and other reactions of astrophysical interest. The quadrupole sextuplet spectrometer has been upgraded by inserting an electrostatic deflection element near the midpoint and by installing a movable beam stop near the ^7Be production target. These changes have allowed an improvement in the purity, and a large increase in the intensity, of the ^7Be beam. Six large NaI(Tl) detectors and the gas cell from the OSU system along with its active and passive shielding [2] have been incorporated into the Lawrence Livermore facility. True events are to be identified by a multiple coincidence. The first requirement is the detection of a γ-ray from the proton capture $\pi Be(p, \gamma)^8B$. After the candidate capture gamma is observed the ^8B decay signature is required. This signature is a positron (from $^8B \rightarrow {}^8Be^* + e^+ + nu$) along with the two α's from $^8Be \rightarrow \alpha + \alpha$ observed in a CaF_2 detector into which the ^8B have implanted. Also a detector telescope inside the gas cell monitors the incoming ^7Be beam. The current status of the $^7Be(p, \gamma)^8B$ measurement is discussed.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

28599 **(JINR-R—3-87-319) Measurement of the thermal cross section of the /sup 36/Cl(n,p)/sup 36/S reaction.** Andrzejewski, J.; Gledenov, Yu.M.; Vertebnyj, V.P. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702448/JAW.

The results are reported on the measurement of the thermal cross section of the (n,p) reaction for the /sup 36/Cl radioactive nucleus. For spectrometry analysis and identification of low-energy charged particles the ionization chamber with two grids was used. For the first time the thermal cross section has been found to be equal σ(n/sub th/,p)=0.4 +-0.1 b. It makes possible to determine the /sup 36/Cl//sup 35/Cl ratio on the 10/sup -8/ level, which could be interesting for the isotope chronology. 24 refs.; 3 figs.

28600 **Limits on axions from nuclear decays.** Hallin, A.L.; Calaprice, F.P.; Dunford, R.W.; McDonald, A.B.; Paulson, G.C. (Princeton Univ., NJ (USA)). pp 276-279 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Recent heavy ion experiments at GSI have revealed anomalous electron-positron coincidences. The anomalous events seem to come from something that decays into a two-body final state. It has been proposed that a 1.8 MeV axion could explain the data. However, both conventional axion theory and more recent variants are inconsistent with existing measurements of electron-positron angular correlations in nuclei. Beam dump experiments also exclude the axion theories. The authors discuss the old data and new measurements in terms of the axion theory and a more general particle explanation for the GSI result.

28601 **Coulomb re-excitation of radioactive nuclei.** Piercey, R.B.; Banda, M.A.H.; Cormier, T.M. (Univ. of Florida, Gainesville (USA)). pp 464-467 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A new technique, Coulomb re-excitation (CRE), is proposed which can be used to study well-deformed far-from-stability nuclei. In CRE a radioactive secondary ion beam is allowed to bombard a high Z target at just under the Coulomb barrier. A special anticoincidence, charged-particle detector is used to suppress background. Low counting rates are predicted but, when expected backgrounds are folded in, CRE data may be statistically superior to higher-rate in-beam data on the same nucleus.

28602 **Neutron emission cross section measurements with a 14 MeV neutron generator.** Gul, K.; Anwar, M.; Saleem, S.M.; Ahmad, M. (Pakistan Institute of Nuclear Science and Technology, Islamabad). pp 496-497 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The PINSTECH 14 MeV Neutron Generator Facility has been used for the measurements of double differential neutron emission cross sections of Al, Cu and Pb in the emitted neutron energy range of 3-14 MeV and in the 30°-130° range. Integrated neutron emission cross sections are given and compared with previously reported values.

28603 **Evidence for toroidal nuclei.** Norbeck, E. (Univ. of Iowa, Iowa City (USA)). pp 498-500 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Recent heavy ion experiments have shown a multifragment breakup mode where most of the mass of the total system is divided among three to five fragments of roughly equal mass. The most striking feature of the mode is its large cross section, up to 22% of the total reaction cross section. The lightest member of the reacting pair ranged from Al to Kr. The beam energies ranged from 11 to 44 MeV/u. The available data can be explained as the breakup of nuclei with a toroidal shape. The model suggests that toroidal

nuclei will be formed in any nuclear reaction if the reactants are heavy enough and the bombarding energy is in the right range.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

28604 Partial neutron cross sections for ^{39}K and ^{41}K between 14.4 and 18.2 MeV. Mii, Y.J.; Williams, J.R.; Alford, W.L.; Ghorai, S.K. (Auburn Univ., AL (USA)). pp 493-495 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Activation techniques have been used to measure the cross sections for the ^{39}K(n, 2n)/sup 38g/K reaction at neutron energies between 14.4 and 18.2 MeV, the cross sections for the ^{41}K(n, α)^{38}Cl reaction from 14.4 to 16.3 MeV and the cross sections for the ^{41}K(N,P)^{41}Ar reaction from 14.4 to 17.3 MeV. Gamma-rays from the decay of the residual nuclei were detected with an HPGe detector whose energy resolution at 1.33 MeV is approximately 1 keV fwhm. The mixed powder method was employed to determine the neutron flux at each neutron energy, and the associated particle method was used to check the mixed powder flux measurements at 14.4 and 15.4 MeV. Good agreement was obtained for the average cross sections computed using both methods. Measured cross sections for the ^{39}K(n, 2n)/sup 38g/K reaction are 2.2 +/- 0.2, 5.8 +/- 0.4, 6.6 +/- 0.5, 14.4 +/- 0.9 and 22.1 +/- 1.5 mb at 14.4 +/- 0.2, 15.4 +/- 0.2, 16.3 +/- 0.1, 17.3 +/- 0.1 and 18.2 +/- 0.1 MeV, respectively. Cross sections for the ^{41}K(n,p)^{41}Ar reaction are 52.9 +/- 2.6, 44.9 +/- 2.1, 41.3 +/- 4.2 and 34.2 +/- 3.0 mb, respectively for the first four neutron energies listed above, and, for the first three energies, the cross sections for the ^{41}K(n, a)^{38}Cl reaction are 34.4 +/- 2.4, 28.5 +/- 2.2 and 24.5 +/- 2.6 mb.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

28605 (JINR-R—15-87-276) B(E2) and B(M1) value correlations in the /sup 58,62/Ni(p,γ)/sup 59,63/Cu reactions. Izosimov, I.N.; Kraft, O.E.; Sigalov, V.M.; Sizov, I.V.; Parzhitskij, S.S. (Leningradskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Fizicheskij Inst.; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702462/JAW.

The problem of the γ-transition reduced probability correlations in the decay of proton resonances with 3/2/sup -/ spin in the /sup 58/Ni(p, γ)/sup 59/Cu, /sup 62/Ni(p, γ)/sup 63/Cu reactions is considered. The existence of such correlation is proved experimentally. That indicates the nonstatistical nature of the investigated resonances. 9 refs.; 4 figs.

28606 Excitation functions of alpha particle induced reactions in cobalt in the energy range 10-120 MeV using variable energy cyclotrons. Rama Rao, J.; Mohan Rao, A.V.; Mukherjee, S.; Upadhyay, R.; Singh, N.L.; Agarwal, S.; Chaturvedi, L.; Singh, P.P. (Banaras Hindu Univ., Varanasi (India)). pp 484-489 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Alpha particle induced reactions on the target element cobalt were investigated from 10 to 120 MeV, using foil stack activation technique and the Ge(Li) gamma ray spectroscopy method. Ten excitation functions for reaction residues ^{51}Cr, /sup 52,54/Mn, /sup 56,57/Ni, ^{59}Fe and /sup 56,57,58,60/Co were measured, of which ^{59}Co(α, p6n)^{56}Ni reaction was measured for the first time. A comparison with pre-equilibrium hybrid model was made using initial exciton number, n_0 = 4 (4pOh). It is observed that for (α, xnypzα) type reactions the agreement is within a factor of 2, while for (α, xnyp) type the disagreement is generally by more than an order of magnitude.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

28607 (JINR-E—1-87-362) Losses and dissipation of pion energy in π/sup -/-xenon collisions at 3.5 GeV/c. Miller, K.; Pluta, J.; Pawlak, T.; Peryt, W.; Strugalski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Polska Akademia Nauk, Warsaw. Inst. Fizyki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702431/JAW.

The dependence of neutral pion characteristics on the number of emitted protons has been investigated in π/sup -/-Xe collisions at 3.5 GeV/c. A reference frame of forward-backward symmetry pion emission was used for data analysis. Pion energy losses has a monotonous character and is directly related to the involved nuclear matter layer thickness. In the case of central collisions the angles and momenta of secondary pions seem to be uniformly distributed. 14 refs.; 5 figs.; 1 tab.

28608 (JINR-R—3-87-117) Some characteristics of p-wave resonances of /sup 111,113/Cd. Alfimenkov, V.P.; Borzakov, S.B.; Mareev, Yu.D.; Pikel'ner, L.B.; Khrykin, A.S.; Sharapov, Eh.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702447/JAW.

The γ-quanta yields for direct transitions near p-wave parity violating /sup 111/Cd and /sup 113/Cd neutron resonances for which parity violating have been obtained earlier have been measured. Investigations were carried out by the time-of-flight method on the IBR-30 pulsed reactor with NaJ(Tl) detector for 45 deg, 90 deg and 135 deg emission angles of γ-quanta. p-resonance spins, partial widths of direct transitions and contribution into neutron widths states with a definite value of channel spin have been obtained. The same characteristics are shown for /sup 117/Sn. Using these data the matrix element values of weak interaction have been determined. 13 refs.; 3 figs.; 2 tabs.

28609 (JINR-R—15-87-530) Study on the /sup 143/Nd(n,α)/sup 140/Ce and /sup 147/Sm(n,α)/sup 144/Nd reactions at 144 keV neutron energy. Andrzejewski, J.; Tkhan', V.K.; Vtyurin, V.A.; Shiong, L.B.; Popov, Yu.P.; Vertebnyj, V.P.; Kirilyuk, A.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702463/JAW.

Alpha spectra from the (n, α) reaction on the /sup 143/Nd and /sup 147/Sm nuclei were measured for quasi-monoenergetic 144 keV neutrons achieved by using the silicon filter. Averaged cross sections were obtained to be 6.6+-1.2 μb and 24.5+-5.6 μb, respectively. For the /sup 147/Sm(n, α)/sup 144/Nd reaction the ratio of reduced α-widths of transitions to the first excited and ground states was found to be 1.31+-0.40. The obtained results do not contradict with the statistical theory, of nuclear reactions. 8 refs.; 4 figs.; 2 tabs.

28610 Coulomb excitation studies in ^{127}I. Cheema, T.S.; Mehta, D.; Arora, B.K.; Trehan, P.N. (Panjab Univ., Chandigarh (India)). pp 457-459 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A low energy proton beam has been used to measure the B(E2) values of different levels in ^{127}I via Coulomb excitation process. The de-excitation gamma ray yields were measured with a 50 cm^3 Ge(Li) detector placed at 55° to the incident proton beam. The iodine target was prepared by pressing KI into pellet form. The proton beam of 3.7 MeV energy was used to excite the levels at 202.8, 375.0, 418.0, 629,0 and 745.5 keV in ^{127}I. The measured values of B(E2) for the above levels are compared with the previous measurements available in literature.

28611 Coulomb excitation of ruthenium isotopes. Arora, B.K.; Mehta, D.; Rani, R.; Cheema, T.S.; Trehan, P.N. (Panjab Univ., Chandigarh (India)). pp 460-463 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The B(E2) values of the 89.4, 340.4, 575.5, 617.4 and 719.2 keV states of ^{99}Ru and 127.2, 306.8, 422.0 and 544.9 keV states of ^{101}Ru have been deduced by measuring the yields of gamma-rays following Coulomb excitation of a metallic ruthenium target with 3.0 MeV protons at Variable Energy Cyclotron, Chandigarh. The gamma-ray spectra were measured at 55° to the beam line using a 50 cm^3 Ge(Li) detector (resolution: 2.5 keV at 1332 keV). The present B(E2) values for different states in ^{99}Ru and ^{101}Ru are compared with the values available in the literature.

28612 Excitation functions for radioactive isotopes produced by alpha particle induced reactions with silver. Singh, N.L.; Agarwal, S.; Chaturvedi, L.; Rao, J.R. (Banaras Hindu Univ., Varanasi (India)). pp 480-483 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Stacked foil activation technique and Ge(Li) γ-ray spectroscopy have been used for the determination of the excitation functions, up to 50 MeV, of seven reactions, ^{107}Ag(α, n), (α, 2n), (α, αn), (α, α2n); ^{109}Ag(α,2n), (α, 3n) and α, 4n). Since natural silver used as the target has two odd-mass stable isotopes of about equal abundance, ^{107}Ag(51.83%) and ^{109}Ag(48.17%), their activation in some cases gives the same residual nucleus through different reaction channels, but with very different Q-values. In such cases, the individual reaction cross sections are separated with the help of the ratio of the theoretical cross sections. The theoretical predictions based on a pre-equilibrium exciton model, with an initial exciton configuration of $n_0 = 5$ (5pOh), appear to give a good fit to the experimental data.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

28613 Nuclear data sheets for A = 168. Shirley, V.S. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Nuclear Data Sheets;* **53**: No. 2, 223-330(Feb 1988). Contract AC03-76SF00098.

Experimental data pertaining to all nuclei with mass A = 168 have been evaluated. Level schemes from both radioactive decay and reaction studies are presented, along with associated tables of experimental data and adopted properties for levels and transitions. copyright 1988 Academic Press, Inc.

28614 Studies of nuclear rotational bands with the spin spectrometer. Riedinger, L.L.; Carpenter, M.P.; Courtney, L.H.; Janzen, V.P. (Univ. of Tennessee, Knoxville (USA)). pp 468-472 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

In the last few years increasingly sophisticated gamma-ray spectrometer arrays have been built at a number of laboratories around the world. These instruments, coupled with versatile heavy-ion accelerators, are capable of probing the detailed behavior of atomic nuclei under extreme conditions of angular momentum and temperature. Characteristics of one such detector array, the Spin Spectrometer at Oak Ridge National Laboratory, are presented here. Representative gamma-ray data are shown, illustrating the practical differences that result from using two unlike accelerator beams to produce the same nucleus. Finally, the application of the data to the question of quasiparticle rotational alignment in light Pt and Au nuclei is discussed.

28615 Long-lived isomers in medium-heavy and heavy deformed nuclei. Sood, P.C.; Sheline R.K. (Banaras Hindu Univ., Varanasi (India)). pp 473-476 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The situation of long-lived (t/sub 1/2/ ≧ 1 s) isomers in deformed nuclei is critically examined both from experimental and theoretical viewpoints. A sequence of isomers with half-lives of the order of seconds and decaying through low-energy (E < 300 keV) gamma rays to the ground states is identified in odd-mass nuclei. The phenomenon is widely occurring in doubly-odd deformed nuclei. For the six rare earth elements with $65 \leqq Z \leqq 75$ and $N \geqq 91$, multiple isomer sets are already known in 25 nuclides and predicted in 10 other isotopes. However, in 16 known cases the characterization is uncertain. For the six transuranium elements, isomer pairs are known in 12 cases and are predicted in 12 other isotopes. Out of the 12 known pairs, only one isomer decays by gamma emission and only three have confirmed energy ordering. Guidelines for their proper characterization and suggestions for identification of undiscovered isomers are presented.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

28616 (INIS-BR—1063) Study of the /sup 197/Au electrodisintegration. Campos, M.C.A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1986. 61p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702326/JAW.

The /sup 197/Au electrodisintegration by neutron emission, aiming to obtain informatons about the isoscalar giant electric quadrupole resonance was studied. The cross section of the /sup 197/Au (e, n)/sup 196/Au reaction, and the yield production of /sup 197/Au (e + γ, n)/sup 196/Au electro + photodisintegration, in function of the energy of incident neutron, between 10 and 23 MeV were measured. A method which relates the electrodisintegration cross section with the corresponding photodisintegration cross section, by the virtual photon spectra was used in the analysis of experimental data. This analysis allows to determine the multipolar composition of photonuclear process.

28617 Nuclear structure of /sup 200/Pt from in-beam conversion-electron and γ-ray spectroscopy. Yates, S.W.; Baum, E.M.; Henry, E.A.; Mann, L.G.; Roy, N.; Aprahamian, A.; Meyer, R.A.; Estep, R. (Department of Chemistry, University of Kentucky, Lexington, Kentucky 40506). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 1889-1895(May 1988).

Low-lying states of /sup 200/Pt have been studied by the /sup 198/Pt(t,pγ) and (t,pe$^-$) reactions with 16-MeV tritons. From detailed p-γ, p-e$^-$, and p-γ-γ coincidence measurements, a level scheme that includes 16 excited states has been established. A 14.3-ns isomer is observed and is believed to correspond to the 7$^-$ isomers prevalent in the lighter even-mass platinum nuclei. Limited comparisons are made with the U(5) and O(6) symmetries of the interacting boson model.

28618 **Nuclear data sheets for A = 199.** Schmorak, M.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6371). *Nuclear Data Sheets;* **53**: No. 2, 331-406(Feb 1988). Contract AC05-84OR21400.

Experimental data pertaining to nuclei with A = 199 are compiled and evaluated. copyright 1988 Academic Press, Inc.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

28619 **Effect of a steep gradient in the potential energy surface on nucleon exchange.** de Souza, R.T.; Huizenga, J.R.; Schroeder, W.U. (Department of Chemistry and Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 1901-1919(May 1988).

Mass number, atomic number, energy, and angular distributions were measured for the projectile-like fragments from the reaction /sup 238/U+/sup 40/Ca at E/sub lab/ = 340 MeV. General features of this reaction are compared to other mass asymmetric systems. Considerable attention is given to the effect of the strong static driving force of the liquid drop (with shell and proximity corrections) potential energy surface on the first and second moments of the observed charge and mass distributions, as well as on associated correlations in the measured two-dimensional probability distribution P(A,Z). Comparison with an appropriate nucleon exchange transport model is made and discrepancies are discussed.

28620 **Absolute yields of some fission products in the fast neutron induced fission of ^{238}U.** Ram, S.; Singh, N.L.; Bose, S.K.; Rama Rao, J. (Banaras Hindu Univ., Varanasi (India)). pp 501-502 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Fission-track registration characteristics of Lexan plastic track detector immersed in aqueous solution of uranyl nitrate have been studied. An attempt has been made to measure absolute fission yields of some fission products in the 14 MeV induced fission of ^{238}U using track etch-cum-gamma ray spectrometry. Yields of 10 fission-products with half life ranging up to several hours and mass numbers in the region 99-157 are reported.

28621 **Analysis of fissionable material using delayed gamma rays from photofission.** Hollas, C.L.; Close, D.A.; Moss, C.E. (Los Alamos National Lab., NM (USA)). pp 503-505 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The energetic gamma-ray spectra from the fission products of photofission have been investigated to determine whether photofission can identify heavily shielded fissionable material. Target samples of natural thorium, 93% enriched ^{235}U, natural uranium, and 93% enriched ^{239}Pu were irradiated with bremsstrahlung gamma rays produced by 10-MeV electrons from a small linear accelerator. The gamma-ray spectra for each of the four isotopes studied reveal a distinctive intensity distribution. For example, the intensity ratio of the pair of gamma rays at 1436 keV (^{138}Cs) and 1428 keV (^{94}Sr) is 1.9 for ^{235}U, 2.4 for ^{238}U, 1.7 for ^{232}Th and 1.4 for ^{239}Pu.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 28360, 28617

28622 **(BONN-IR—87-43) Light-front deuteron vertex function.** Gotzes, S. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Nov 1987. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753230/JAW.

In the present thesis a model of a deuteron vertex function was elaborated which is analytic and explicitely covariant. The single topics of the calculations are summarized: First a coordinate system was introduced in which the Lorentz invariance corresponds to a rotational invariance, and its equivalence to the light-front coordinate system respectively to the system of infinite momentum is shown. Karmanov's (1976) calculation of the wave function with one-boson exchange potential in this coordinate system was reproduced. Because this calculation was performed in the Kadyashevskij formalism it was necessary to put the equation corresponding to the Bethe-Salpeter equation in this formalism in relation to the Bethe-Salpeter equation. Thereafter it was possible to decomposite the wave function calculated by Karmanov in the usual way in invariant functions and express them by rotational-invariant quantities of the Karmanov system. Because these rotational invariants for the wave function with one-boson-exchange potential were calculated Lorentz-invariant analytic expressions for these invariant functions could be established. (orig./HSI).

28623 **(CBPF-NF—051/87) Effect of nuclear binding energy on pion. Yields in relativistic nuclear collisions.** Medeiros, E.L.; Duarte, S.J.B.; Kodama, T. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702218/JAW.

An alternative way for including the nuclear binding energy in intranuclear cascade calculations of relativistic heavy-ion collisions is presented. The present model strictly conserves the total energy and momentum of the system. Pions are produced only via the formation of Δ-resonances and the pion absorption is taken into account through the delta recombination reaction. This simple treatment leads to a correct description of the pion multiplicity in the Ar + KCl reaction case. The proton and pion energy spectra calculated within this model agree with the data.

28624 **(GSI—88-13(prepr.)) Vacuum polarization effects in subbarrier nuclear fusion reactions.** Assenbaum, H.J.; Langanke, K.; Soff, G. (California Inst. of Tech., Pasadena (USA). W.K. Kellogg Radiation Lab.; Muenster Univ. (Germany, F.R.). Inst. fuer Theoretische Physik 1). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); California Inst. of Tech., Pasadena (USA). W.K. Kellogg Radiation Lab.; Muenster Univ. (Germany, F.R.). Inst. fuer Theoretische Physik 1). Feb 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753246/JAW.

We evaluate the influence of the Uehling potential on the subbarrier fusion of light elements. Noticeable modifications of the barrier penetrability are obtained for systems ranging from α+/sup 12/C up to /sup 28/Si+/sup 28/Si.

28625 **(IFUSP-P—666) Statistical decay of the E1 giant resonance.** Teruya, N.; Dias, H.; Wolynec, E. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702269/JAW.

Available esperimental data on neutron decay spectra from the E1 giant resonances in /sup 208/Pb and /sup 209/Bi are compared with the predicted spectra for statistical decay. The calculations are performed using the Hauser-Feshbach formalism with the experimental levels of the residual nuclei. The particle-vibrator model is used to assign spins and parities to experimental levels when those are unknown and also to predict the levels where there is not enough experimental information.

28626 **(IFUSP-P—667) E2, E4 and E6 statistical decay spectra in /sup 208/Pb.** Teruya, N.; Wolynec, E.; Dias, H. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702270/JAW.

Statistical decay spectra for the decay of giant resonances in /sup 208/Pb are calculated using Hauser-Feshbach formalism and the experimental levels of the residual nucleus. The predicted decay spectra are compared with available experimental results.

28627 (ITEP—180(1986)) Transverse momentum analysis for the reactions Ca + Ca and Nb + Nb at E/A=400 MeV in the molecular-dynamical model. Kiselev, S.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702407/JAW.

The results of a global transverse-momentum analysis carried out on the basis of the molecular-dynamical model are presented for the reactions Ca+Ca and Nb+Nb at E/A=400 MeV. The model satisfactorily reproduces the mean transvers momentum per nucleon projected into the reaction plane as a function of the center-of-mass rapidity. However it overestimates the flow recently introduced by K.G.R. Doss et al. (the slope of the function mentioned above at zero rapidity). 11 refs.; 3 figs.

28628 (ITF—86-122) Role of proton polarizability in the p+p -> d+e/sup +/+ν reaction at astrophysical low energies. Belyaev, V.B.; Kuz'michev, V.E. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702409/JAW.

It is shown that the accounting of the proton polarizability in the p+p -> d+e/sup +/+ν reaction leads to the essential change of the energy dependence of the cross section in the domain 0<E0.5 keV. The dependence of the value, characterizing the deuteron yield on the temperature turns out to be differ from the one calculated in the standard theory: it has an additional peak at the temperature near 0.05 keV, which is congruent to its value at T = T/sub C/ = 1.3 keV. An estimate of the influence of this effect on the "boron" neutrino flux from the sun is given. 11 refs.; 6 figs.

28629 (ITF—86-136) Calculation of the d(t,n)α reaction cross section and the /sup 5/He nucleus 3/2/sup +/ resonance parameters. Vasilevskij, V.S.; Gutich, I.F.; Okhrimenko, I.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702410/JAW.

The cross section of the d(t,n)α reaction, the characteristics of the /sup 5/He nuclei 3/2/sup +/ resonance. S-factor and some other values are calculated in the framework of the multichannel variant of an algebraic version of the resonating group method. The comparison with the earlier results and experiment is made. 14 refs.; 2 figs.; 2 tabs.

28630 (ITP—86-135) Off-energy description of two-particle interaction by the boundary condition method. Petrov, N.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702419/JAW.

Using the boundary conditions method the approach allowing one to describe the off-energy-shell two-particle interaction is formulated. The off-energy wave function is expressed explicitly through the half-energy amplitude scattering function for which the first-order linear differential equation is obtained. The Noyes-Kowalski representation in terms of half-energy values is found for the off-energy-shell scattering amplitude. 22 refs.

28631 (ITP—86-166) Sp(4,R) model realization of the magic nuclei case. Blokhin, A.L. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702420/JAW.

The algorithm to realize Sp(4,R) nuclear model is proposed in the case of closed nuclear shells. The algorithm is based on the recursive procedure which allows one, having the various operators generating matrix elements on Sp(4,R) discrete series generalized coherent states been set, to calculate these operators partial matrix elements between the Sp(4,R) group basic functions with arbitrary quantum numbers. 21 refs.

28632 (LPN-UM—124) Report of activities no. 18, 1983. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire). 1983. 142p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702466/JAW.

The two accelerators at the Laboratoire de physique nucleaire, the tandem van de Graaff and the dynamitron, are being used less often for fundamental physics studies and more frequently in solid state physics, metallurgy, medicine, etc. Activities in applied nuclear physics were augmented by the acquisition of new surface analysis equipment, and the carbon-11 tracer program is developing. Fundamental nuclear physics research includes studies of the energy levels of /sup 16/N. The theoretical nuclear physics group is oriented towards the study of nucleon-nucleon diffusion in the quark model, the nuclear physics-particle physics interface, gauge theory, the skyrmion model, and the nuclear physics-astrophysics boundary. Work is being carried out on data acquisitions systems.

28633 (LPN-UM—125) Report of activities no. 19, 1984. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire). 1984. 147p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702467/JAW.

The accelerators at the Laboratoire de physique nucleaire are no longer used for fundamental nuclear research, but have found a new role in studies of solid state physics, microelectronics, biochemistry, and applied physics. Accelerators at TRIUMF, CERN, Chalk River and other locations are being used for more fundamental studies in lepton production, instrumentation, and particle physics. Another major project is the development of a data acquisitions system for an 8-pi spectrometer. The theoretical physics group is working in the areas of nucleon-nucleon diffusion in the quark model, gauge theory, and the skyrmion model.

28634 (LPN-UM—127) Report of activities no. 20, 1985. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire). 1985. 156p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702468/JAW.

In particle physics, the group involved in the HELIOS collaboration finished the adjustment of the different connections while finishing the adaptation of the analysis programs. The OPAL group now has a test laboratory in which to complete the electronic circuit including the amplifiers for the signals from the z chamber. The nuclear spectroscopy program used the local accelerators to start experiments, but called on other accelerators for high-energy beams. The 8-pi detector is well on the way to completion; the Laboratory's contribution is centered on the electronics and the data acquisitions system. The research program in theoretical physics included work in systems of small numbers of nucleons and on mass formulas and their application to astrophysics. The applied physics program made the local accelerators available to outside collaborators. Specialized beam paths are being made available for PIXE and channeling, and there is a new irradiation chamber for high energy implantation. The /sup 11/C production system reached a crucial phase this year and is being evaluated.

28635 (LYCEN—8718) Calculation of the spin-isospin response functions in an extended semi-classical theory. Chanfray, G. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France)). 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753185/JAW.

We present a semi-classical calculation of the spin isospin response-functions beyond Thomas-Fermi theory. We show that surface-peaked Planck constant/sup 2/ corrections reduce the collective effects predicted by Thomas-Fermi calculations. These effects, small for a volume response, become important for surface responses probed by hadrons. This yields a considerable improvement of the agreement with the (p, p') Los Alamos data.

28636 F-spin vector effects in inelastic electron scattering from low-lying collective states of /sup 154/Gd. Wenes, G.; Otsuka, T.; Ginocchio, J.N. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 Department of Physics, Japan Atomic Energy Research Institute, Tokai, Ibaraki, 319-11, Japan). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 1878-1883(May 1988).

F-spin admixtures are predicted in the non-yrast states of / sup 154/Gd. The neutron-proton interacting boson model boson quadrupole transition densities are determined from electron scattering and are shown to have important F-spin vector effects.

28637 Y scaling in a simple quark model. Kumano, S.; Moniz, E.J. (Department of Physics, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 2088-2097(May 1988).

A simple quark model is used to define a nuclear pair model, that is, two composite hadrons interacting only through quark interchange and bound in an overall potential. An equivalent hadron model is developed, displaying an effective hadron-hadron interaction which is strongly repulsive. We compare the effective hadron model results with the exact quark model observables in the kinematic region of large momentum transfer, small energy transfer. The nucleon response function in this y-scaling region is, within the traditional framework, sensitive to the nucleon momentum distribution at large momentum. We find a surprisingly small effect of hadron substructure. Furthermore, we find in our model that a simple parametrization of modified hadron size in the bound state, motivated by the bound quark momentum distribution, is not a useful way to correlate different observables.

28638 Monopole strength as a measure of nuclear shape mixing. Heyde, K.; Meyer, R.A. (Institute for Nuclear Physics, Proeftuinstraat, 86 B-9000 Gent, Belgium). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 2170-2175(May 1988).

A survey of observed E0 transition strength shows that some of the largest strength occurs for transitional nuclei whenever large mixing between almost spherical and largely deformed shapes results. This leads to the conclusion that large E0 strength is not an indication of coexisting shapes but of strong mixing between nuclear states with largely different radii. In addition, we discuss the variation of E0 transition rates in regions where intruder states become the nuclear ground state. We illustrate this by recent results in the A≅100 region concentrating especially on the anomalously large monopoles strength and its variation in the even-even N = 60 isotones as compared with the N = 58 isotones.

28639 T expansion and the Lipkin model. Perez, R.; Cambiaggio, M.C.; Vary, J.P. (Departamento de Fisica, Comision Nacional de Energia Atomica, 1429 Buenos Aires, Argentina). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 2194-2198(May 1988).

We apply the t-expansion method of Horn and Weinstein to the SU(2) soluble model of Lipkin. The method is shown to approximate well both the ground state and the first excited state energies. An extension to a dynamically determined reference state is explored and shown to dramatically improve results for the region of strong coupling.

28640 Analyses of nucleon spectra in heavy ion reactions. Blann, M.; Remington, B.A. (Physics Department, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 2231-2232(May 1988). Contract W-7405-ENG-48.

We discuss uncertainties in extracting precompound neutron spectra and multiplicities by commonly used methods.

28641 Detailed balance description of energetic photons in heavy-ion collisions. Prakash, M.; Braun-Munzinger, P.; Stachel, J.; Alamanos, N. (Physics Department, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 1959-1967(May 1988).

Photon production cross sections in intermediate energy heavy-ion reactions are calculated using detailed balance. The model gives substantial photon yields and reproduces qualitatively the experimental observations. A possible influence of the Δ-isobar degree of freedom on the high energy photon yield is pointed out.

28642 Exact and approximate sum rules for inclusive breakup reactions. Udagawa, T.; Tamura, T.; Mastroleo, R.C. (Department of Physics, University of Texas, Austin, Texas 78712). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 5, 2261-2263(May 1988).

The sum rule formalism of Ichimura, Austern, and Vincent, constructed for inclusive breakup reactions based on the distorted-wave Born approximation, is compared critically with the exact sum rule formalism. This presents a possible explanation of why the former formalism overpredicts cross sections.

28643 Pattern of J/psi suppression in ultrarelativistic heavy-ion collisions. Chu, M.; Matsui, T. (Center for Theoretical Physics, Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **37**: No. 7, 1851-1855(1 Apr 1988).

We calculate the transverse-momentum dependence of J/psi suppression in ultrarelativistic heavy-ion collisions, assuming the existence of a characteristic energy density ϵ_s above which no J/psi could be formed. Bjorken's longitudinal-scaling hydrodynamics is used to describe the system in the central rapidity region. The transverse-momentum dependence of J/psi suppression observed in the recent CERN NA38 experiment colliding 200-GeV/nucleon oxygen on uranium can be understood in our model if $\epsilon_s \geq 0.7$ GeV/fm^3. We also make predictions for 200-GeV/nucleon sulfur-uranium interactions.

28644 Interacting boson approximation. Casten, R.F.; Warner, D.D. (Brookhaven National Laboratory, Upton, New York 11973). *Reviews of Modern Physics;* **60**: No. 2, 389-470(Apr 1988).

The IBA-1 is reviewed with particular emphasis on the symmetry structure that arises naturally from its inherently algebraic approach. The formulation of the model, in both its algebraic and its numerical aspects, is presented and the basic character of its predictions is discussed and compared with nuclear data. The limitations of the model, and efforts to ameliorate these by appropriate extensions, are also reviewed in some detail. An effort is made to provide a simple, transparent understanding of the basic physics by clarifying the relation of the mathematical structure to underlying physical ideas, and to provide guidance in understanding and carrying out practical calculations.

6540 Radiation And Shielding Physics

28645 (AD-A—188537/5/XAB) Energetic-particle radiation environment for manned space operations. Shea, M.A.; Smart, D.F. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1985. 12p. (AFGL-TR—87-0275). NTIS, PC A03/MF A01.

Pub. in Solar Terrestrial Predictions, 390-400(1986).

Manned operations in space involves, by necessity, an increased radiation exposure from three distinct and unique sources. These are: (1) Background galactic cosmic radiation which is always present and against which shielding is relatively ineffective. (2) The trapped-particle flux in the magnetosphere which has a large variation with altitude and against which shielding is relatively effective. (3) Solar particles which are primarily of concern of polar orbits. For the low-altitude earth operation the primary radiation flux is a constant exposure to the background cosmic radiation and the low-altitude trapped radiation.

28646 (JINR-R—4-87-460) Modelling the reflection of neutrons from a one-dimensional row of nuclei. Korneev, D.A.; Chernenko, L.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702452/JAW.

The method is described for calculating the coefficient of reflection of low-energy neutrons from the boundary of a model medium that is a discrete sequence of nuclear planes. The calculation procedure constructed on the basis of the method has been verified for simplest models of structures, and it allows one to com-

pute a spectral dependence of the neutron-reflection factor from films of thickness <or approx. 1 μ. The method can be applied to study thin films inhomogeneous in composition by comparing the experimental and calculated values of the reflection factor in a wide interval of neutron wavevectors in the region of both specular reflection and diffraction. 7 refs.; 6 figs.

28647 (RI—188) Characteristics of thick-target bremsstrahlung for electrons of complex spectral composition. Kornyakov, A.P. (Radievyj Inst., Leningrad (USSR)). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702482/JAW.

Analytical ratios for calculation of photon number, photon mean energy and total energy of thick-target bremsstrahlung for electrons of complex spectral composition are obtained. The calculation bremsstrahlung characteristics for electrons of β-spectrum (/ sup 90/Y source) and for spectrum approximation of exponential energy function in the case of their complete absorption in different targets (Z=13-73) are compared with the data of numerical calculations and experiments. 15 refs.; 5 tabs.

28648 Focusing of undulator light at SPEAR with a lacquer-coated mirror to power densities of 10/sup 9/ watts/cm/ sup 2/. Tatchyn, R.; Csonka, P.; Kilic, H.; Watanabe, H.; Fuller, A.; Beck, M.; Toor, A.; Underwood, J.; Catura, R. (Stanford Univ., Stanford, CA (USA)). pp 368-378 of Soft x-ray optics and technology. Koch, E.E.; Schmahl, G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-861242—).

From International conference on soft X-ray optics and technology; West Berlin, F.R. Germany (8 Dec 1986).

A lacquer-coated, diamond turned Cu ellipsoid has been used to micro-focus undulator light from Beam Line V at SPEAR down to a half-power diameter of about 13 microns. This spot was source-size limited, as has been demonstrated with ray tracings of the optical system. The symmetry of the image, as well as its size and power density, clearly make this optic ideal for many soft x-ray applications, in particular for x-ray microscopy, microprobes, and for pumping soft x-ray transitions in various media.

28649 Element-sensitive computed tomography with fast neutrons. Overley, J.C. (Univ. of Oregon, Eugene (USA)). pp 1058-1062 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Pulsed-beam, time-of-flight techniques are used to measure the energy dependence of a collimated, fast-neutron continuum transmitted through an object. By comparing results to similar measurements on pure elements, number densities of elements projected along the neutron beam path are deduced. The method is applied to a translate-rotate scan of an object ~ 15 cm in diameter containing hydrogen, carbon, nitrogen, oxygen, phosphorus, and calcium. Techniques of computed tomography are then used to determine the spatial distribution of the various elements in a plane slice of the object. Several factors affecting precision and accuracy are discussed.

28650 Computerized microtomography using synchrotron radiation from the NSLS. Spanne, P.; Rivers, M.L. (Linkoeping Univ. (Sweden)). pp 1063-1067 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Results of microtomography experiments that employ filtered radiation from the National Synchrotron Light Source X-26 Microprobe beam line are presented. These experiments have yielded images of a freeze-dried caterpillar with a spatial resolution of the order of 30 μm and show that the limit on the spatial resolution with the present apparatus will be 1 to 10 μm. Directions for improvements in synchrotron microtomography techniques and some possible applications are discussed.

28651 Neutron therapy and dosimetry at the UCLA neutron therapy facility. Smathers, J.B.; Myers, L.T. (Univ. of California, Los Angeles (USA)). pp 1077-1081 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

On July 1, 1986, just short of 7 years from the date of contract award. The UCLA Neutron Therapy Facility began patient treatment. The facility, one of four supported by The National Cancer Institute neutron therapy clinical trials program, uses a 46 MeV negative-ion-proton cyclotron and the reaction (p, Be(26)) (the target is sufficiently thick to absorb 26 MeV of the incident proton energy), to create a spectrum of neutrons having a mean energy of approximately 20 MeV. Dosimetric calibration of the beam is performed using A-150. Tissue Equivalent Plastic ion chambers and the methods contained in The AAPM Task Group 18, Neutron Dosimetry Protocol. Clinical treatment planning is accomplished using the Tissue Air Ratio techniques developed for photon dosimetry and adapted for the UCLA neutron spectrum. Dosimetric results and clinical experience up to the time of presentation will be discussed.

28652 Calculated stopping cross sections for diamond and solid silicon and germanium. Sabin, J.R.; Oddershede, J. (Univ. of Florida, Gainesville (USA)). pp 339-342 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The Bethe stopping cross section of diamond, Si and Ge for protons has been calculated using the kinetic theory of stopping and valence electron momentum densities derived from experimental Compton profiles. Trends along the isovalent, isostructural series are discussed, and comparison with experimental stopping cross sections lead to mean excitation energies of the order I(Ge) = 310 eV, I(Si) = 173 eV and I(diamond) = 96 eV. It is also shown that care should be exercized when using graphite data for describing the stopping of diamond.

28653 Recent relative stopping power measurements by monoenergetic methods. Leite, C.V.B.; Baptista, G.B.; Patnaik, B.K. (Texas A & M Univ., College Station (USA)). pp 343-346 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A discussion about a new experimental method for stopping power determination is presented. Using this monoenergetic method, relative stopping values for $^{4}He^{+}$ ion beams on ^{13}Al were obtained. The He^{+} beam energies varied from 2.6 to 0.3 MeV in steps of a factor K (kinematic factor) to provide a relative stopping power curve. The normalization of the relative values was done using independent measurements at 2.0 and 1.0 MeV. The agreement between the present results and the tabulated values show the feasibility of the method. The present monoenergetic method is well suited as an option for the transmission method, and opens a new perspective to the study of the stopping of charged particles and correlated effects like straggling and beam density.

28654 Energy straggling for fast proton beams passing through solid materials. Kido, Y. (Toyota Central Research and Development Labs., Aichi-ken (Japan)). pp 347-352 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Energy straggling for fast proton beams passing through solids has been investigated using nuclear resonance reactions with narrow natural widths such as $^{19}F(p, \alpha\gamma)^{16}O$ and $^{27}(Al(p, \gamma)^{28}Si$. The straggling value is determined by best fitting the simulated excitation spectrum of the γ-ray yields to the corresponding experimental one assuming a Gaussian energy-loss distribution. Thus the energy and Z_0 dependence of energy straggling is studied systematically for 20 monoatomic and 4 compound targets. The results are compared with theoretical predictions proposed so far. Furthermore, the additivity rule on energy straggling for compound materials is also discussed.

28655 Stopping power uncertainty effects in thick target RBS analysis. Niiler, A. (Army Ballistic Research Lab., MD (USA)). pp 358-361 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Stopping powers are one of the major factors that affect the accuracy of Rutherford backscattering analysis methods. Their role becomes most important when thicknesses greater than 0.5 mg/cm^2 are probed with hydrogen beams of 1.0 MeV or less. The analysis of data taken under these conditions require energy loss values near the peak of the stopping power curve where the uncertainties can reach 15% or more. The RBS simulation code PROFILE is used to analyze samples containing Cu, Ni and Al with several different sets of stopping powers. The results indicate that a given uncertainty in the stopping power may lead to equivalent uncertainties in elemental concentrations and thicknesses of coatings.

28656 Energy loss of 1.3-2.6 MeV ^{4}He ions in Havar, nickel, Kapton and Mylar foils. Rauhala, E.; Raeisaenen, J. (Univ. of Helsinki (Finland)). pp 362-365 of Application of accelerators in research and industry '86: Proceedings, Part 1. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.1).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The energy loss of 1300-2610 keV ^{4}He ions in 1.99 μm Havar, 2.72 μm nickel, 10.87 μm Kapton and in 3.68 μm, 6.83 μm and 7.30 μm aluminized (40 nm Al) Mylar foils have been determined. Good agreement with the calculated values obtained by using Bragg's rule and the Ziegler semiempirical parameters was found in the Havar and nickel cases. Maximum deviations of 1% from the semiempirical curves were observed. In the case of the Kapton and Mylar foils, however, maximum deviations of even 8% for Kapton and 13% for Mylar were obtained. By using appropriate approximations the stopping power values from the thick foil energy loss data were determined for Havar, nickel and Mylar. The Mylar stopping power was found to be independent of the foil thicknesses used. The stopping data are compared with the available literature values. The applicability of the foil materials as exit foils in external beam setups are discussed.

6550 Medical Physics

REFER ALSO TO CITATION(S) 27490, 28279

28657 (INIS-BR—1053) Evaluation of uncertainties in X radiation metrologic chain in the Secondary Standard Dosimetry Laboratory/IRD-Brazilian CNEN. Fonseca Coelho, B.C. da. (Rio de Janeiro Univ. (Brazil)). 1987. 131p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702317/JAW.

The equipment to measure ionizing radiation used in medicine needs appropriate technical qualifications to comply with their purposes and regular calibrations to assure the correct evaluation of associated quantities. By legal requirements, the annual calibration of users' dosemeters is to be done in a Secondary Standard Dosimetry Laboratory (SSDL), andthe SSDL'S standard dosemeters are refered to a Primary Standard Dosimetry (PSDL), establishing a rigourous metrological network. The SSDL network. The SSDL needs to maintain, regularly, a quality control program for short and Long term stability of standard dosemeters. The purpose of the work was to determine the uncertainties associated to technical procedures of X-rays calibration at the SSDL/IRD/IRD. To evaluate the influence of the nine main parameters that can give origin to uncertainties, specific procedures and methods are established, according to international requirements and recomendations. The methods are based on the comparison of the behaviour of the users' dosemeters, with a standard dosemeter in the many measuring conditions set up for the secondary standard used as a reference. The total uncertainty obtained was 1,81% usig a conservative procedure, to protect the users and patients. When needed to transfer the calibration factor and their uncertainty, the procedure used was to determine the uncertainty under the worsst possible operating conditions of the equipment, to obtain a superestimated value. This represents an excellent result for an SDDL of IAEA Network. (autor).

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 27943

28658 (AD-A—189008/6/XAB) Free-electron laser - far-infrared study of Fef2:Mn. Report No. 1, January 1986-January 1987. Spector, J.; Kaminski, J.; Jaccarino, V. (California Univ., Santa Barbara (USA)). 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Solid State Communications, Vol. 63, No. 12, 1093-1095(1987).

The first use of a free-electron laser (FEL) for condensed-matter research was made on iron fluoride:manganese with the far-infrared radiation from the UCSB FEL. The versatility of the FEL for linear and nonequilibrium spectroscopy is demonstrated in studies of the host and impurity modes.

28659 (IC—87/215) Closed-form solutions for the highly anisotropic antiferromagnetic chain. Lagos, M.; Cabrera, G.G. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702244/JAW.

We obtain the spectrum and derive closed-form solutions for the stationary states of the one-dimensional antiferromagnetic Heisenberg Hamiltonian in the quasi-Ising asymptotic limit. Comparison with exact numerical results for the ground state shows, however, good accuracy in a wide range of the anisotropy parameter. Since our solutions are simple and in closed analytical form a deep insight in the dynamics of linear antiferromagnets is obtained. The structure of the ground state presents similarities with the liquid-type disordered state proposed by Anderson. (author). 6 refs, 1 fig.

28660 (IC—87/219) Phonon-assisted two-photon exciton transitions in semiconductors. Hassan, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702247/JAW.

The theory of phonon-assisted two-photon transitions to excitonic states in semiconductors has been theoretically investigated. The effects of both the nonparabolicity of the band and the degeneracy of the valence band have been taken into account. Expressions for the absorption coefficient through different band models are calculated. The numerical applications to CdI/sub 2/ and GaP show that the 4-band model gives the dominant contribution which leads to a final s-exciton state. An exciton peak appears at an energy which is close to that recently observed in CdI/sub 2/. The non-parabolic effect enhances the absorption coefficient by a two-order of magnitude. (author). 6 refs, 1 fig., 1 tab.

28661 (IC—87/220) Direct and indirect two-photon excitonic processes in solids. Hassan, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702248/JAW.

The theory of direct and indirect two-photon transitions to exciton states has been theoretically investigated in semiconductors.

The effects of the nonparabolic bands and the degeneracy of the valence band have been taken into account. Expressions for the absorption coefficient through the most energetic band models are calculated. The numerical applications to a number of semiconductors show that: (i) For the direct process, the three-band model, where the third band is the spin-orbit splitting valence band gives the largest contribution to the absorption coefficient. The transition mechanism through this model leads to an s-like state. (ii) In the indirect process, the four-band model dominates the other models which leads also to a final s-exciton state. An exciton peak appears at photon energy which is close to that recently observed in CdI/sub 2/. The nonparabolic effect enhances the absorption by a factor of two in the case of the direct process and by two order of magnitude in the indirect one. (author). 9 refs, 2 figs, 2 tabs.

28662 (IC—87/224) Dilute spin-one Ising model with both bilinear and biquadratic exchange interactions. Saber, M. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702252/JAW.

The influence of bond and site dilution on the two-dimensional spin-one Ising model on a honeycomb lattice is investigated. Temperature-concentration phase diagrams for fixed values of the ratio of bilinear and biquadratic exchange interactions are determined. (author). 7 refs, 3 figs.

28663 (IC—87/228) Mean field renormalization group for the bond dilute spin-1 Ising model. Elkenz, A.; Saber, M. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702255/JAW.

A new type of renormalization group theory that has recently been used with success for many applications concerning the usual two-state Ising model is herein extended to the bond dilute spin-1 Ising model. The (T-p) phase diagrams have been evaluated for the square and simple cubic lattices. (author). 9 refs, 2 figs, 1 tab.

28664 (IC—87/229) Effective mass approximation for tunneling states with dissipation. Chen Hong; Wu Xiang. (Tongji Univ., Shanghai SH (China). Pohl-Inst. of Solid State Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702256/JAW.

The dissipative tunneling in an asymmetric double-well potential is studied at low temperature. With effective mass approximation, the dissipation can be replaced by a temperature-dependent effective mass. The effective mass increases with decreasing temperature and becomes infinite at T=0. The partition function of the system is derived, which has the same form as that of a non-dissipative tunneling system. Some possible applications in glasses and heavy fermion system are also discussed. (author). 21 refs, 1 fig.

28665 (IC—87/230) Method for calculation of momentum matrix element in tight-binding approach. Xu Zhizhong. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702257/JAW.

With the Wigner-Eckart theorem we have deduced formulas for the momentum matrix elements in the tight-binding approach in terms of some constant parameters. With the aid of k-vectorcenter dotp-vector perturbation theory these parameters can be determined by second derivative of energy with respect to the wave vector k-vector. These formulas have been applied to III-V compound semi-conductors and the clear expressions have been obtained. (author). 3 refs.

28666 (IC—87/232) High-order perturbation formula for EPR trigonal symmetric g/sub i/-value of d/sup 8/ ion. Huang Ming. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702258/JAW.

The full three-order and quasi fourth-order perturbation formulae for the EPR trigonal symmetric g/sub i/-value of the ground state /sup 3/A/sub 2/ of d/sup 8/ configuration have been derived under the assumption of strong field approximation. Using this formula, the μkα-correlation field model and d-orbital theory suggested by Zhao, the g-factor for a number of compounds, namely, RbNiCl/sub 3/, NiCl/sub 2/, (CH/sub 3/)/sub 4/NNiCl, CaNiBr/sub 3/, NiBr/sub 2/, (CH/sub 3/)/sub 4/NNiBR and RbNiBr/sub 3/ has been calculated without any adjustable parameter. Our theoretical results agree well with the experimental findings. (author). 7 refs, 1 tab.

28667 (INIS-BR—1037) Thermodymical, optical and X-rays studies of some thermotropic liquid crystals. Porath, M. (Santa Catarina Univ., Florianopolis (Brazil)). 1986. 82p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702301/JAW.

The temperatures and enthalpies of transition were studied for the compound p-cyane metane-4 (trans 4'-n-pentylcyclohexyl) biphenyl as well as layer spacing (d) and intermolecular distance (as a funtion of temperature). These data together with the texture are used to identify the mesophase present. In compounds of the series p(4-n-alcoxybenzoiloxy) benzilidene 4'-n-decanoxyaniline temperature and enthalpies of transition were measured and textures observed. The intermolecular distance (D), layer spacing (d) as well as the indexes of refraction (all as a funtion of temperature) were also measured. The mesophases were identified based on these data.

28668 (INIS-BR—1043) Rapid Thermal annealing of silicon layers amorphized by ion implantation. Hasenack, C.M. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1986. 113p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702307/JAW.

The recrystallization behavior and the supression mechanisms of the residual defects of silicon layers amorphized by ion implantation, were investigated. The samples were annealed with the aid of a rapid thermal annealing (RTA) system at temperature range from 850 to 1200/sup 0/C, and annealing time up to 120 s. Random and aligned Rutherford backscattering spectroscopy were used to analyse the samples. Similarities in the recrystallization behavior for layers implanted with ions of the same chemical groups such as As or Sb; Ge, Sn or Pb, In or Ga, are observed. The results show that the effective supression of resisual defects of the recrystallired layers is vinculated to the redistribution of impurities via thermal diffusion.

28669 (INIS-BR—1058) Impurities of oxygen in silicon. Gomes, V.M.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 214p. (In Portuguese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702321/JAW.

The electronic structure of oxygen complex defects in silicon, using molecular cluster model with saturation by watson sphere into the formalism of Xα multiple scattering method is studied. A systematic study of the simulation of perfect silicon crystal and an analysis of the increasing of atom number in the clusters are done to choose the suitable cluster for the calculations. The divacancy in three charge states (Si:V/sub 2//sup +/, Si:V/sub 2//sup 0/, Si:V/sub 2//sup -/), of the oxygen pair (Si:O/sub 2/) and the oxygen-vacancy pair (Si:O.V) neighbours in the silicon lattice, is studied. Distortions for the symmetry were included in the Si:V/sub 2//sup +/ and Si:O/sub 2/ systems. The behavior of defect levels related to the cluster size of Si:V/sub 2//sup 0/ and Si:O/sub 2/ systems, the insulated oxygen impurity of silicon in interstitial position (Si:O/sub i/), and the complexes involving four oxygen atoms are analysed. (M.C.K.).

28670 (INIS-BR—1059) Microscopic models of impurities in silicon. Assali, L.V.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 199p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702322/JAW.

The study of electronic structure of insulated and complex puntual impurities in silicon responsible by the appearing of deep energy levels in the forbiden band of semiconductor, is presented. The molecular cluster model with the treatment of surface orbitals by Watson sphere within the formalism of Xα multiple scattering method, was used. The electronic structures of three clusters representative of perfect silicon crystal, which were used for the impurity studies, are presented. The method was applied to analyse insu-

lated impurities of substitutional and interstitial hydrogen (Si:H and Si:H/sub i/), subtitutional and interstitial iron in neutral and positive charge states (Si:Fe/sup 0/,/sup +/, Si:Fe/sup 0/,/sup +/) and substitutional gold in three charge states(Si,Au/sup -/,/sup 0/,/sup +/). The thetraedic interstitial defect of silicon (Si:Si/sub i/) was also studied. The complex impurities: neighbour iron pair in the lattice (Si:Fe/sub 2/), substitutional gold-interstitial iron pair (Si:Au/sub s/Fe) and substitutional boron-interstitial hydrogen pair (Si:B/sub s/H/sub i/), were analysed. (M.C.K.).

28671 (INIS-mf—11198) Neutron depolarization study of static and dynamic magnetic properties of ferromagnets. Stuesser, N. (Technische Univ. Delft (Netherlands)). 16 Oct 1986. 91p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702375/JAW.

Contains summary in Dutch and previously published material.

In this thesis neutron depolarization experiments are performed on amorphous and crystalline ferromagnetic materials. The subjects studied are concerned with 'domain structure in magnetically weak uniaxial amorphous ferromagnetic ribbons', 'static critical behaviour at the ferromagnetic-paramagnetic phase transition', 'small magnetic anisotropy in nickel near T/sub c/', and 'magnetization reversal in conducting ferromagnets'. 87 refs.; 37 figs.; 3 tabs.

28672 (INIS-mf—11206) Nuclear magnetic resonance study of conformational transmission in phosphorylated pyranosides. Vries, N.K. de. (Technische Univ. Eindhoven (Netherlands)). 18 Sep 1987. 100p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702383/JAW.

Contains summary in Dutch and previously published material.

This thesis describes an experimental NMR study, combined with MNDO calculations, on the conformational preferences of the exocyclic bond of 6-phosphorylated pyranosides and tetrahydropyran-2-methyl compounds. The various factors influencing the rotamer population distribution around this O-C-C-O fragment, e.g. solvent polarity, stereoelectronic effects and coordination of phosphorus, are analysed. 150 refs.; 25 figs.; 16 tabs.

28673 (PB—88-860291/XAB) Sputter coating of tantalum and tantalum compounds. January 1970-March 1988 (Citations from the NTIS data base). Report for January 1970-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 56p. NTIS PC N01/MF N01.

Supersedes PB—86-865342.

This bibliography contains citations concerning the properties of tantalum and tantalum compound films formed by sputtering techniques. Topics include the types of technique used, and electrical, magnetic, and dielectric properties. Studies of tantalum compounds including nitrates, oxides, and aluminides are presented. The structural properties of sputtered films are also discussed. (This updated bibliography contains 98 citations, 12 of which are new entries to the previous edition.)

28674 Universal behavior near the band edges for disordered systems: Numerical and coherent-potential-approximation studies. Li, Q.; Soukoulis, C.M.; Economou, E.N. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **37**: No. 14, 8289-8297(15 May 1988). Contract W-7405-ENG-82.

The integrated densities of states (DOS) of one-, two-, and three-dimensional tight-binding models with diagonal and off-diagonal disorder are calculated numerically. Our results for the diagonal-disorder case confirm the expected universal behavior of the DOS, particularly near the band edges. The simple exponential behavior of the DOS is clearly displayed in the three-dimensional results. The off-diagonal-disorder case follows a universal behavior too, which agrees reasonably well with the coherent-potential-approximation (CPA) results. Our results are compared with the various phenomenological theories, with the CPA conclusions, and with previous numerical results.

28675 Electronic states of doped semiconductor superlattices in magnetic and electric fields. Ulloa, S.E.; Kirczenow, G. (Department of Physics and Astronomy and Condensed Matter and Surface Sciences Program, Ohio University, Athens, Ohio 45701-2979). *Physical Review [Section] B: Condensed Matter;* **37**: No. 14, 8337-8345(15 May 1988).

A theoretical treatment of the effects of external fields on the electronic properties of doped semiconductor superlattices is presented. Self-consistent calculations of the level structure in the presence of strong magnetic fields reveal the existence of surfacelike states associated with the depletion regions at the ends of the superlattice. These states lie in the gap between Landau levels during Landau-level emptying and closely track the Fermi energy throughout the range of magnetic fields where the Hall plateaus occur. These results explain important features observed in recent experiments by Stoermer et al., such as the Hall quantization index and the anomalously small activation energy. The character of the surfacelike states can be strongly affected by varying the applied magnetic field and especially by the simultaneous application of an electric field in the direction perpendicular to the layers. The large sensitivity to applied fields suggests novel experimental arrangements which would directly probe the density of states of the system.

28676 Steady-state segregation in diffusion-limited reactions. Lindenberg, K.; West, B.J.; Kopelman, R. (Department of Chemistry, B-040, University of California at San Diego, La Jolla, California 92093). *Physical Review Letters;* **60**: No. 18, 1777-1780(2 May 1988).

The conditions for a macroscopic segregation of A and B in a steady-state $A+B \rightarrow 0$ reaction are studied via a finite continuum model. Segregation occurs in $d = 1$, is marginal for $d = 2$ (critical dimension), and is absent for $d \geq 3$. Results for infinite systems are also mentioned.

28677 Pluralism in the critical phenomena of the one-dimensional continuous-spin Ising model. Baker G.A. Jr. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review Letters;* **60**: No. 18, 1844-1847(2 May 1988).

A concrete example is given which shows that the one-dimensional Ising and Gaussian model universality classes do not exhaust the universality classes of the one-dimensional continuous-spin Ising model. Thus the normal universality hypothesis fails in this simple, readily analyzable model.

28678 Velocity reset method of simulating thermal motion and damping in gas—solid collisions. Riley, M.E.; Coltrin, M.E.; Diestler, D.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **88**: No. 9, 5934-5942(1 May 1988). Contract AC04-76DP00789.

We present a velocity reset procedure for the approximate description of the molecular dynamics of a tractable subset of the atoms composing a macroscopic solid which is subjected to collisions. The coupling of the subset to the remainder (the reservoir) is taken into account in a stochastic manner by periodically resetting the velocities of subset particles which interact with the reservoir. The Cartesian velocity components are reset to v/sup new/ = $(1-\theta)^{1/2}$v/sup old/ + $\theta^{1/2}$v/sup T/, where v/sup old/ is the previous velocity, v/sup T/ is a random velocity chosen from a Maxwellian distribution at temperature T, and θ is a parameter which controls the strength of the reset. In the limit $\theta = 1$ and all subset particles are reset, the method is similar to Andersen's thermostat procedure [J. Chem. Phys. 72, 2384 (1980)]. In the double limit that $\theta \rightarrow 0$ and the interval between resets Δt/sub r//sub s/ $\rightarrow 0$ such that $\beta = \theta/2\Delta t$/sub r//sub s/ is fixed, the equations of motion for the subset reduce to Langevin form, where β is the frictional damping rate. This partial velocity reset method is a computational procedure allowing for (1) relaxation dynamics which are equivalent to the frictional damping theories, (2) inclusion of nonzero temperature effects on damping, (3) rapid generation of initial states selected from a canonical ensemble in preparation for individual transient scattering events, and, (4) simulations akin to molecular dynamics. We show that the velocity reset method reproduces previ-

ous calculations of the energy accommodation for the collision of an atom with a simple cubic lattice.

28679 Hall effect for Kondo systems. Levy, P.M.; Guo, W.; Cox, D.L. (Department of Physics, New York University, 4 Washington Place, New York, New York 10003). *Journal of Applied Physics;* **63**: No. 8, 3896-3898(15 Apr 1988).

We have calculated the variations with temperature of the skew scattering contribution to the Hall effect for a Kondo-type ion. The conduction electron t matrix is calculated by using the single-ion Anderson model, and the 4f electrons' Green's function is evaluated by self- consistently solving a set of integral equations. Except for the asymptotic region T/T/sub k/>>1, the Hall constant is not proportional to the susceptibility, nor does the constant change sign for realistic values of the parameters entering the theory.

28680 Fractal surface finish. Church, E.L. (U.S. Army Armament Research, Development, and Engineering Center, Picatinny Arsenal, New Jersey 07806-5000). *Applied Optics;* **27**: No. 8, 1518-1526(15 Apr 1988).

Surface finish measurements are usually fitted to models of the finish correlation function which are parametrized in terms of root-mean-square roughnesses, σ, and correlation lengths, l. Highly finished optical surfaces, however, are frequently better described by fractal models, which involve inverse power-law spectra and are parametrized by spectral strengths, K/sub n/, and spectral indices, n. Analyzing measurements of fractal surfaces in terms of σ and l gives results which are not intrinsic surface parameters but which depend on the bandwidth parameters of the measurement process used. This paper derives expressions for these pseudoparameters and discusses the errors involved in using them for the characterization and specification of surface finish.

28681 Integrated on-line instrumentation for simultaneous automated measurement of magnetic field, induction, Barkhausen effect, magnetoacoustic emission, and magnetostriction. Jiles, D.C. (Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **63**: No. 8, 3946-3948(15 Apr 1988).

A microcomputer-controlled instrument for simultaneous measurement of magnetic hysteresis, magnetostriction, Barkhausen effect, and magnetoacoustic emission is described. It incorporates custom designed software for control of the magnetic field during operations such as demagnetization, field sweeping, and anhysteretic magnetization, and for data logging and analysis. Results are recorded using a 12-bit analog to digital converter and are then stored on floppy disk. The magnetic hysteresis data are converted into six important magnetic parameters: coercivity, remanence, hysteresis loss, initial permeability, maximum differential permeability, and anhysteretic permeability. These, together with the magnetostriction, Barkhausen, and magnetoacoustic emission, are then related to the microstructure of the material.

28682 One-dimensional Dzyaloshinski—Moriya antiferromagnets in an applied field. Xia, Q.; Riseborough, P.S. (Department of Physics, Polytechnic University, 333 Jay Street, Brooklyn, New York 11201). *Journal of Applied Physics;* **63**: No. 8, 4141-4143(15 Apr 1988).

We examine the one-dimensional antiferromagnet, with a small Dzyaloshinski—Moriya component to the exchange, in a symmetry-breaking magnetic field. In the classical, continuum limit, this system is shown to obey a double sine-Gordon field theory which supports nonlinear, soliton excitations as well as linear, spin waves. We examine the dynamic spin-spin correlation function. We find the contributions coming from the nonlinear soliton excitations and the contributions from the quantized linear excitations. The quantized spin waves produce nonlinear contributions to the correlation functions that exhibit qualitative similarities to the soliton contributions.

28683 Laser-induced emission of ions and neutrals from the surfaces of transparent optical media. Chase, L.L.; Gdowski, G. (Livermore National Lab., P.O. Box 5508, Livermore, CA 94550 (US)). pp 192 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper FBB 5.

The mechanisms involved in the interaction of intense laser beams with the surfaces of transparent optical media have been difficult to study in a controlled manner. The authors found that a promising experimental approach to this problem is the study of laser-induced particle emission from clean surfaces in an ultrahigh-vacuum environment. An earlier study was reported on ion and electron emission from a number of insulators and wideband gap semiconductors. Multiphoton excitation apparently plays a role in the charged emission. They subsequently obtained evidence that the charge emission is caused by multiphoton ionization that takes place in a flux of emitted neutrals leaving the surface. The neutral emission component is, therefore, more directly related to the laser excitation of the surface.

28684 Applications of synchrotron radiation topography to dynamic processes in single crystal materials. Dudley, M. (State Univ. of New York, Stony Brook (USA)). pp 1068-1072 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Synchrotron radiation topography has been used to investigate, in situ, large (cm^3) single crystals undergoing dynamic processes. These investigations include (1) studies of the plastic deformation of Fe-3.5 wt% Si single crystals, and (2) studies of the solid state polymerization of PTS single crystals. The uniqueness and versatility of the technique for such studies is clearly demonstrated. The deformation studies have shown that the surface orientation of the Fe-3.5 wt% Si single crystals relative to the slip Burgers vector exerts a strong influence on the slip morphology even in bulk samples. Results obtained from the solid state polymerization studies have shown that when the reaction is initiated thermally, as opposed to photolytically and radiolytically, dislocations play a role in accelerating the reaction kinetics.

6561 Superconductivity

REFER ALSO TO CITATION(S) 27719, 27720, 27763, 27764, 28503

28685 (IC—87/164) High-temperature superconductivity. An overview. Ginzburg, V.L. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 31p. (CONF-8707109—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702051/JAW.

From Adriatico conference on high temperature superconductors; Trieste, Italy (6 Jul 1987).

After a short account of the history of experimental studies on superconductivity, the microscopic theory of superconductivity, the calculation of the control temperature and its possible maximum value are presented. An explanation of the mechanism of superconductivity in recently discovered superconducting metal oxide ceramics and the perspectives for the realization of new high-temperature superconducting materials are discussed. 56 refs, 2 figs, 3 tabs.

28686 (IC—87/217) Hole pairing induced by antiferromagnetic spin fluctuations. Su, Z.B.; Yu Lu; Dong, J.M.; Tosatti, E. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702246/JAW.

The effective interaction induced by antiferromagnetic spin fluctuations is considered in the random phase approximation in the context of the recently discovered high T/sub c/ oxide superconductors. This effective attraction favours a triplet pairing of holes.

The implications of such pairing mechanism are discussed in connection with the current experimental observations. (author). 30 refs, 2 figs.

28687 (INIS-BR—1062) Study of superconducting properties in some many valley semiconductors. Silveira, H.V. da. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1986. 84p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702325/JAW.

The problem of superconducting transition in many valley semiconductors is considered, within a two band model. The dominant mechanism comes from the attractive interaction between electrons of different valleys. The intravalley pairing is neglected since the shielding is very strong. Using the Green's function method, properties of the superconducting state are obtained, such as: quasiparticle spectrum, density of state and transition temperature. The a.c. - conductivity is calculed using the general theory of linear response. For the particular case the chalcogenide PbTe:Tl the effect of random impurities on the conductivity is considered. The results obtained for the transition temperature as a function of the carrier concentration are compared with the experimental results. The conductivity is checked against know theoretical results.

28688 (JINR-R—5-87-231) Molecule consisting of two quantum vortexes in two-dimensional Bose Gas. Principal equations. Kaschieva, V.A.; Kaschiev, M.S.; Puzynin, I.V.; Men'shikov, L.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702453/JAW.

In the Hartree-Fock approximation an expression for nonhomogeneity energy for a two-dimensional Bose gas is obtained taking into account the quantum corrections. It is shown that the nonhomogeneity of the Bose-condensate is equivalent to the existence of a potential well in which bound states for the gas atoms always exist (for the two-dimensional case). When atoms pass from the Bose-condensate to these states, there is and energy gain - the physical meaning of quantum corrections. As an example of nonhomogeneity, a molecule consisting of two quantum vortexes with opposite rotation of the superflowing component is considered. 4 refs.; 1 fig.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 27584, 28392, 28571, 28578, 28646

28689 (CBPF-MO—004/87) Discrete variational methods and their application to electronic structures. Ellis, D.E.; Guenzburger, D. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Northwestern Univ., Evanston, IL (USA)). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702215/JAW.

Some general concepts concerning Discrete Variational methods are developed and applied to problems of determination of eletronic spectra, charge densities and bonding of free molecules, surface-chemisorbed species and bulk solids. (M.W.O.).

28690 (CBPF-NF—050/87) On the distribution equations. Oliveira Castro, F.M. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 10p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702217/JAW.

A fundamental problem of variational calculus is generalized and its correspondent Euler equation is obtained from generalized distribution equations. (autor).

28691 (CBPF-NF—055/87) Meaning of energy diagrams used to describe hetero-structures. Helman, J.S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702219/JAW.

Energy diagrams used to describe superlattices built by alternate doping are based aon electrostatics, while those for heterostructures use potential barriers to simulate the effect of interferences produced by periodic potentials limited in space.

28692 (CBPF-NF—056/87) Time travel in the homogeneous Som-Raychaudhuri Universe. Paiva, F.M.; Reboucas, M.J.; Teixeira, A.F.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702220/JAW.

Properties of the rotating Som-Raychaudhuri homogeneous space-time are investigated: time-like and null geodesics, causality features, horizons and invariant characterization. An integral representation of its five isometries is also discussed.

28693 (CBPF-NF—061/87) On the operator p/sup 4/ + V(r). Bollini, C.G.; Giambiagi, J.J.; Helman, J.S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702224/JAW.

Eigenvalues and eigenfunctions of the operator d/sup 4//dr/sup 4/+V(r) are discussed for different examples. A generalization of the usual harmonic oscillator is discussed for fourth order equations in the Appendix. (autor).

28694 (GSI—88-11(prepr.)) On energy conservation in the presence of collision terms. Buck, P.; Feldmeier, H.; Nemes, M.C. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jan 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753244/JAW.

In the derivation of dissipative equations of motion it is a necessity to incorporate the global conservation laws into the approximations. Among the constants of motion usually the Hamiltonian itself is the most intricate one. The main purpose of this paper is to show that in a quite general approximation scheme, which is based on a projection on macro-observables followed by a perturbation expansion, the quest for energy conservation dictates how to split the Hamiltonian into an unperturbed part and a perturbation. In this scheme energy is conserved to each order separately if the unperturbed Hamiltonian is the projected part of the full Hamiltonian. The very general considerations are exemplified with Zwanzig's projection method and with the extended time dependent Hartree-Fock equations.

28695 (IC—87/67) On existence and nonexistence of some harmonic maps. Hong, J.X.; Liu, J.Q. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702238/JAW.

Let S/sup 1.1/ denote the submanifold of Lorentz space R/sup 2.1/, which is composed of all points l with l/sup 2/=1 and let T/sup 1.1/=R/sup 1.1//ZxZ. In this paper we study the existence of nontrivial harmonic maps from T/sup 1.1/ to S/sup 1.1/ and H/sup 2/ and construct a harmonic map for any homotopy class of maps from T/sup 2/ to S/sup 1.1/. (author). 3 refs.

28696 (IC—87/214) Fibre bundles associated with fields of geometric objects and a structure tensor. Konderak, J. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702243/JAW.

A construction of a k/sup th/ structure tensor of a field of geometric objects is presented here (k is a non-negative integer). For a given field σ we construct a vector bundle H/sup k,2/(σ). The k/sup th/ structure tensor is defined as a section of H/sup k,2/(σ) generated by the torsion of σ. It is then shown that vanishing of the k/sup th/ structure tensor is a necessary and sufficient condition for the field to be (k + 1)-flat. (author). 16 refs.

28697 (IC—87/222) Artificial noise due to DC electric trains. Senanayake, W.E. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702250/JAW.

The current distribution in a DC railway and the resulting magnetic effects have been modelled using the parameters of the DC railway networks in Italy. The results show that the magnetic perturbations are substantially high in the vicinity of electrified railway lines. The order of magnitude of the induced field can be as significant as ~ 40nT at a distance of ≃ 2km from the railway line indicating that geophysical techniques that employ natural magnetic anomalies can be badly effected, within this range. The magnetic effects rapidly decay with increasing distance, but the noise level could be significant even at a range of ~ 10km. Also, these induced anomalies vary significantly with the conductivity of the ground. When the conductivity is high it is possible that the railway currents dispersed through the ground interact with those induced in the earth, causing a severe disruption to the telluric measurements. (author). 11 refs, 10 figs, 1 tab.

28698 (IC—87/223) Levinson's theorem for non-local interactions. Ma Zhongqi; Dai Anying. (International Centre for Theoretical Physics, Trieste (Italy); Industrial Inst. of Beijing, BJ (China)). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702251/JAW.

The Levinson theorem for a Schroedinger equation with both local and non-local symmetric potentials is studied in terms of the Sturm-Liouville theorem. A new convention for the phase shifts is applied instead of the usual one. It is proved that the usual Levinson theorem holds for the case with both local potential and non-local symmetric cutoff potential which is not necessary to be separable. The problems related with the positive energy bound states and the physical redundant states are also discussed in this paper. (author). 17 refs.

28699 (IC—87/225) Graph representation of permutation groups - I. Abdel Gawad, A.G.A.E.; Mahmoud, I.M.I. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702253/JAW.

The paper discusses how to construct a graph representing a permutation group and how to illustrate much of the basic relations between its elements by graphs. 6 refs, 4 figs, 2 tabs.

28700 (IC—87/233) Cauchy problems of nonlinear wave equations in three and four space dimensions. Chen Yunmei. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702259/JAW.

In this paper, it is proved that the "null condition" implies the global existence of the solutions to Cauchy problems of nonlinear wave equations, where the nonlinear term contains the unknown function itself, for small initial data in three and four space dimensions. (author). 13 refs.

28701 (IFT-P—01/88) Factorization method and supersymmetry. Alves, N.A.; Drigo Filho, E. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1988. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702260/JAW.

Applying the factorization method, we generalize the harmonic - oscillator and the Coulomb potentials, both in arbitrary dimensions. We also show that this method allows the determination of the superpotentials and the supersymmetric partners associated with each of those systems.

28702 (IFT-P—02/88) Many-lagrangian classical systems. Kraenkel, R.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1988. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702261/JAW.

Sufficiency conditions for the existence of two independent Lagrangians for classical systems with two degrees of freedom are given and related to the complete integrability of the system.

28703 (IFT-P—31/87) Analytic approximation for the chemical potential of an ideal boson system. Aguilera-Navarro, V.C.; Estevez, G.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702262/JAW.

The expansion in Dirichlet series for the Bose-Einstein integral function is reverted to find the fugacity of the system. The ensuing result and the Pade approximation technique are judiciously blended for determining a simple and accurate expression for the reduced chemical potential of a boson system, valid for arbitrary values of the Bose-Einstein integral.

28704 (IFT-P—33/87) Pade approximants and the potential of a point charge between infinite capacitor plates. Aguilera-Navarro, V.C.; Solano Torres, W.; Estevez, G.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil); Bogota Univ. Nacional (Colombia). Dept. de Fisica). (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702264/JAW.

The conventional infinite series representing the electrostatic potential of a point charge between two grounded conducting plates are know to be slowly convergent. It is shown that straight foward application of the Pade approximation technique to accelerate convergence of the series permits accurate computation of the potential.

28705 (IFUSP-P—640) Mie scattering near the critical angle. Fiedler-Ferrari, N.; Nussenzveig, H.M. (Sao Paulo Univ. (Brazil). Inst. de Fisica; Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). (Sao Paulo Univ. (Brazil). Inst. de Fisica). May 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702267/JAW.

Complex angular momentum theory is applied to the problem of high-frequency critical light scattering by a spherical cavity near the critical angle. The main contributions to the scattering arise from a critical domain close to critical incidence. The results are in good agreement with the exact Mie solution.

28706 (IFUSP-P—662) Some historical aspects on the Compton effect. Barranco, A.V. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1987. 19p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702268/JAW.

It is exposed the cronology of the Compton effect, relating the evolution of Quantum Theory to the several interpretation of this phenomenon. (M.W.O.).

28707 (IFUSP-P—669) On energy conservation in the presence of collision terms. Buck, P.; Feldmeier, H.; Nemes, M.C. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). (Sao Paulo Univ. (Brazil). Inst. de Fisica). Nov 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702272/JAW.

The main purpose of this paper is to show that in a quite general approximation scheme, which is based on a projection on macro-observables followed by a pertubation expansion, the quest for energy conservation dictates how to split the Hamiltonian into an unperturbed part and a perturbation. In this scheme energy is conserved to each order separately if the unperturbed Hamiltonian is the projected part of the full Hamiltonian.

28708 (JINR-E—2-87-507) Evaluation of quantum mechanics path integrals by the approximations exact on a class of polynomial functionals. Lobanov, Yu.Yu.; Shidkov, E.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702434/JAW.

Submitted to the International CERN-JINR school of physics, Varna, Sep 1987.

The method for numerical evaluation of path integrals in Eucledean quantum mechanics without lattice discretization is elabo-

rated. The method is based on the representation of these integrals in the form of functional integrals with respect to the conditional Wiener measure and on the use of the derived approximate exact on a class of polynomial functionals of a given degree. By the computations of non-perturbative characteristics, concerned the topological structure of vacuum, the advantages of this method versus lattice Monte-Carlo calculations are demonstrated. 22 refs.; 6 figs.

28709 **(JINR-E—4-87-667) Perturbation expansions generated by an approximate propagator.** Znojil, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702435/JAW.

Starting from a knowledge of an approximate propagator R at some trial energy guess E/sub 0/, a new perturbative prescription for p-plet of bound states and of their energies is proposed. It generalizes the Rayleigh-Schroedinger (RS) degenerate perturbation theory to the nondiagonal operators R (eliminates a RS need of their diagnolisation) and defines an approximate Hamiltonian T by mere inversion. The deviation V of T from the exact Hamiltonian H is assumed small only after a substraction of a further auxiliary Hartree-Fock-like separable "selfconsistent" potential U of rank p. The convergence is illustrated numerically on the anharmonic oscillator example. 7 refs.; 7 tabs.

28710 **(JINR-E—5-87-480) Double anharmonic potential ax/sup 2/+bx/sup 4/+cx/sup 6/ and the extended continued fractions.** Znojil, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702436/JAW.

The sextic anharmonic-ascillator bound-state problem is considered, with an intention to extend its nonperturbative continued-fractional $b > 0$ solution to all couplings. Starting from its specific Hill-determinant treatment the authors employ a recurrent factorization of the related non-hermitean Hamiltonian and arrive at a complete nonperturbative solution represented in terms of the so-called extended continued fractions. The underlying less standard mathematical questions (singularities, convergence) are also clarified and, in particular, a systematic algebraic acceleration of convergence is proposed. In this way, both completion and improvement of the original constructions is achieved. 11 refs.

28711 **(JINR-E—5-87-481) Structure of bound states in polynomial potentials.** Znojil, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702437/JAW.

For an arbitrary polynomial potential, a rigorous construction of the corresponding difference Schroedinger equation and its non-variational asymptotical physical boundary conditions is given. The two alternative solution methods are also described. If applicable, the method of Hill determinants may be recovered as the simple special case. 12 refs.

28712 **(JINR-R—2-87-391) Quadrupole interaction of particles in relativistic mechanics.** Shavokhina, N.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702443/JAW.

A four-particle problem is formulated with a quadrupole interaction between the relativistic particles. This is a new type of interaction in mechanics. The proposed model of four-particle interaction is a generalization of the models earlier studied by the author of the interaction of two and three particles, and it is based only on metric concepts of space-time such as the length of a line, areas of surfaces of two and three dimensions, and the measure of space-time itself. The general form of action of the system is considered; equations of motion are derived from the principle of least action, and constants of motion are found. The model is shown to describe new types of spatially limited relativistic objects. 20 refs.; 1 fig.

28713 **(JINR-R—2-87-514) On new solutions of Chew-Low equations.** Rerikh, K.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702445/JAW.

The system is investigated of Chew-Low equations for S-matrix elements as functions of the uniformizing variable w in terms of which this system is a system of nolinear difference equations. The quadratic Cremona transformation for unknown functions reducing the initial equations to a more simple form is found. New particular solutions as series in variable z=e/sup lnλw/ convergent in a vicinity of the coordinate origin in the plane z are obtained. The computation algorithm for obtained solutions for any values of z is presented, the nearest poles and a graphic representation of solutions are obtained. 11 refs.; 1 fig.

28714 **(JINR-R—2-87-617) Remark to hydrodynamical theory of multiple production.** Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702446/JAW.

Basing on the concept of relativistic length and the following "elongation formula" the way of solving the known difficulty of hydrodynamical theory of multiple production involving the contradiction with quantum uncertainty principle is pointed to. 6 refs.; 1 fig.

28715 **(JINR-R—5-87-373) Cauchy problem for the nonlinear Schroedinger equation.** Zhidkov, P.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702454/JAW.

The theorems of existence, uniqueness and continuous dependence upon the initial condition for the Cauchy problem are proved for the nonlinear Schroedinger equation. There is not a proposition that the solution tends to zero as the space variable tends to infinity in contrast to other papers. Only the continuity and boundedness of initial data and belonging of initial data derivatives to L/sub 2/(R) are proposed. 14 refs.

28716 **(JINR-R—11-87-377) Configuration of particle drain for the high energy charged particles in the magnetic dipole field.** Amirkhanov, I.V.; Zhidkov, E.P.; Ignatov, V.V.; Il'ina, A.N.; Il'in, V.D.; Kuznetsov, S.N.; Yushkov, B.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation; Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702458/JAW.

The boundary of particle leakage from the magnetic dipole trap depending on the value of adiabatic parameter is investigated. By trajectory computation a generalized analytical expression is determined for the shape of particle drain by $x \leqq 1$. It is shown that generally accepted adiabatic loss cone is a particular case of $x \to 0$. 5 refs.; 5 figs.

28717 **(NBI-HE—87-77) Hidden BRS invariance in classical mechanics. Pt. 2.** Gozzi, E. (Niels Bohr Inst., Copenhagen (Denmark)). Dec 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753280/JAW.

In this paper we give more details of a path-integral formulation of classical mechanics previously proposed by this author. This formulation has an unexpected BRS and antiBRS invariance that helps in rewriting the classical generating functional in a compact and revealing form in term of superfields. In this paper we also try to bridge the gap between the usual formulation of classical mechanics and ours: in particular we study the meaning of the auxiliary fields and the ghost fields. These last turn out to be nothing else than the Jacobi fields of classical mechanics and the ghost-charge conservation the well-known Liouville theorem. Next we proceed from the path-integral to find the corresponding operatorial formal-

ism. The operator formulation of classical mechanics that emerges is the one associated to the Liouville operator (liouvillian): a formulation proposed by Liouville long ago as equivalent to the Hamilton one and widely used in classical statistical mechanics.

28718 (NBI-HE—87-78) Phase effect in the harmonic oscillator. Rohrlich, D. (Niels Bohr Inst., Copenhagen (Denmark)). Dec 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753281/JAW.

After a complete circuit in its phase space, the quantum harmonic oscillator acquires a phase of -1, which is in principle observable.

28719 (NBI-HE—87-83) O(3)-symmetric tunneling at false vacuum decay in general relativity. Berezin, V.A.; Tkachev, I.I.; Kuzmin, V.A. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). (Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Dec 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753283/JAW.

The O(3)-symmetric vacuum decay is investigated in general relativity in thin-wall approximation. The following processes are studied: the spontaneous nucleation of a new phase bubble containing a remnant of an old phase inside; a subbarrier transition of a new phase bubble with the non-vanishing total energy from a subcritical state to the infinite expansion; the vacuum decay in the vicinity of a black hole; the creation from nothing of the Universe containing a bubble. General formulae for bounces for all these processes are derived.

28720 (NBI-HE—87-85) O(3)-invariant tunneling in general relativity. Berezin, V.A.; Tkachev, I.I.; Kuzmin, V.A. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). (Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Dec 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753284/JAW.

We derived a general formula for the action for any O(3)-invariant tunneling processes in false vacuum decay in general relativity. The general classification of the bubble Euclidean trajectories is elaborated and explicit expressions for bounces for some processes like the vacuum creation of a double bubble, in particular in the vicinity of a black hole; the subbarrier creation of the Einstein-Rosen bridge, creation from nothing of two Minkowski worlds connected by a shell etc., are given.

28721 (NBI-HE—88-02) On the quantum mechanics of bubbles. Berezin, V.A.; Kozimirov, N.G.; Tkachev, I.I.; Kuzmin, V.A. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). (Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Jan 1988. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753286/JAW.

We study the problem of quantization of pure vacuum bubbles when there is a vacuum with vanishing energy density both inside and outside the bubble while the surface energy density of the bubble is not equal to zero. Taking into account effects of gravity we derive both continuous and discrete spectra of bubbles. In the limit of vanishing gravity the discrete spectrum disappears.

28722 (UWThPh—1987-29) On the asymptotics of nodes of L/sup 2/-solutions of Schroedinger equations in dimensions greater equal 3. Hoffmann-Ostenhof, M.; Hoffmann-Ostenhof, T. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik; Vienna, Univ. (Austria). Inst. fuer Theoretische Chemie und Strahlenchemie). (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702486/JAW.

Let Ω/sub R/=R/sup n/B/sub R/ where n≧3 and B/sub R/{x is an element of R/sup n/:chemical bondxchemical bond≦R}. We investigate the asymptotics of real valued solutions psi is an element of L/sup 2/(Ω/sub R/) of the Schroedinger equation (-Δ+V-E)psi=0, where E<0 and V(x)->0 for chemical bondxchemical bond->∞ : Let D denote an unbounded nodal domain of psi(i.e. a component of Ω/sub R/ {x:psi(x)=0}) and let S(r)={y is an element of S/sup n-1/:ry is an element of D} with S/sup n-1/ the unit sphere in R/sup n/. Under suitable assumptions on V it is shown that for some γ>0 lim inf/sub r->∞/r/sup γ/∫/sub S(r)/psi/sup 2/dσ/ ∫/sub S(sup n-1)/psi/sup 2/dσ >0 and lim inf/sub r->∞/ ln(Volume(D intersection B/sub r/))/lnr≧(n+1)/2. Results of this type are already non trivial for radial problems with psi satisfying non radial boundary conditions on ∂Ω/sub R/ or for exited states of the Hydrogen atom if one considers linear combinations of different l-waves. 25 refs.

28723 Monte Carlo calculation of the quantum partition function via path integral formulations. Kono, H.; Takasaka, A.; Lin, S.H. (Department of Basic Technology, Faculty of Engineering, Yamagata University, Yonezawa 992, Japan). *Journal of Chemical Physics;* **88**: No. 10, 6390-6398(15 May 1988).

Using Bennett's Monte Carlo (MC) method, we calculate the quantum partition functions of path integral formulations. First, from numerically exact results for a harmonic oscillator and a double-well potential, we discuss how fast each approximate partition function converges to the exact value as the number of integral variables involved in the formulation is increased. It turns out that most effective and most suitable for the MC simulation is Takahashi and Imada's path integral fomulation based on a modified Trotter formula in which the original potential is replaced with an effective one. This formulation is well balanced between the following two factors: the effect of zero potential energy is underestimated, resulting in an improper increase in the partition function; and, on the other hand, effective potential restricts the motion of fictitious particles born in the formulation so that the partition function value tends to be smaller. Fictitious particles can be treated as classical ones. We therefore can apply Bennett's MC method to calculating the ratio of two quantum partition functions (of a system under consideration and a reference system). As the number of fictitious particles N is increased, choice of reference system becomes less and less important and multistage sampling becomes dispensable. This, to some extent, compensates for the expense that N is larger than the real particle number. The tunneling mechanism of fictitious particles in the simulation is discussed.

28724 On the denominator function for canonical SU(3) tensor operators. II. Explicit polynomial form. Louck, J.D.; Biedenharn, L.C.; Lohe, M.A. (Los Alamos National Laboratory, Theoretical Division, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York);* **29**: No. 5, 1106-1117(May 1988).

The canonical resolution of the multiplicity problem for tensor operators in SU(3) is equivalent to the map (the denominator mapping) from the set of all SU(3) unit tensor operators to SU(3) invariant functions (the denominator functions). The denominator function vanishes precisely on that characteristic null space that specifies each operator uniquely since [for SU(3)] the characteristic null spaces are known to be simply ordered. Each denominator function can be expressed, up to explicitly known multiplicative factors, as a ratio of two successive polynomials in the set {G/sup t//sub q/}, t = 0,1,..., q+1, q = 0,1,... . By obtaining explicitly the set of all polynomials {G/sup t//sub q/}, this paper completes the construction of all SU(3) denominator functions.

28725 Physical properties of linear and action-angle coordinates in classical and quantum mechanics. Leacock, R.A. (Iowa State Univ., Ames (USA)). *Foundations of Physics;* 17: No. 8, 799-807(Aug 1987). Contract W-7405-ENG-82.

The quantum harmonic oscillator is described in terms of two basic sets of coordinates: linear coordinates, x, p/sub x/, and angular coordinates e/sup i phi/, p/sub phi/ (action-angle variables). The angular coordinate e/sup i phi/ is assumed unitary, the conjugate momentum p/sub phi/ is assumed Hermitian, and e/sup i phi/ and p/sub phi/ are assumed to be a canonical pair. Two transformations are defined connecting the angular coordinates to the linear coordinates. It is found that x, p/sub x/ can be physical, i.e., Hermitian and canonical, only under constraints on the p/sub phi/ eigenvalue spectrum. The conclusion is that e/sup i phi/ can be a unitary operator. A parallel analysis of the classical harmonic oscillator is done with equivalent results.

28726 Nuclear spin noise and spontaneous emission. Hahn, E.L.; Sleator, T.; Hilbert, C.; Clarke, J. (UC-Berkeley, Physics Dept., Berkeley, CA 94720 (US)). pp 218 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper FNN 1.

Spontaneous emission from nuclear spins is measured for the first time, the authors believe. This is possible because of the use of a low-noise SQUID amplifier with noise temperature (—0.2 K) less than that of the 1.5 K helium bath. The spontaneous emission power is —5 - 10% of the background circuit Nyquist noise, which corresponds to the ratio of the effective spin resistance R/sub s/ (proportional to the nuclear susceptibility) and circuit resistance R. Although only one spin flip occurs per 10/sup 8/ yr due to spontaneous emission, the effect is magnified, because all 10/sup 22/ spins in the sample contribute independent of the temperature. This technique implies that spectra of spins can be measured without the requirement of a net polarization and might be useful for samples where spin lattice relaxation times are impractically long. Radiation damping terms which are added to the Bloch equations allow for spin noise analysis of power flow between the spin system and cavity. The equivalence is obtained of predictions of Nyquist's theorem at all spin temperatures T/sub s/ and bath temperatures T in conformity with the predictions of the Einstein detailed balance equation for spontaneous emission. The model of a macroscopic spin pendulum applies where fluctuation through a mean square angle <θ/sup 2/> from magnetization alignment along the polarizing field accounts for coupling of the fluctuating spins to the single-cavity mode. Several aspects of the model for spin noise analysis are applicable to inverted two-level systems.

70 FUSION ENERGY

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7001 Plasma Research

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28727 (AD-A—188878/3/XAB) Effects of toroidal forces in current loops embedded in a background plasma. Interim report. Chen, J. (Naval Research Lab., Washington, DC (USA)). 29 Dec 1987. 41p. (NRL-MR—6086). NTIS, PC A03/MF A01.

A study is made of dynamical properties of a three-dimensional semi-toroidal current loop embedded in a high-temperature stratified background plasma. The model loop carries a toroidal current density J/sub t/ and poloidal current density J/sub p/, producing the magnetic field components B/sub p/ and B/sub t/, respectively. Starting with a non-forces-free current loop in stable MHD equilibrium described by (i/c) J x B - div p O where the major radial forces as well as the minor radial forces are explicitly balanced, the dynamical properties resulting from major radial pertubations are investigated. The condition for instability is given in terms of a circuit parameter, epsilon, which is a measure the flux associated with the overall current distribution. The current loop is due to the toroidal geometry of the pressure gradient and drag force due to the ambient gas. For the equilibrium loops studied, the motion is found to be subsonic. Time evolution of the loops and the magnetic energy converted via drag heating are presented. Results are also presented for loops with relatively strong current and magnetic fields which are not in equilibrium initially. It is found that for sufficiently large current, a current loop can be driven supersonically through the background gas, accompanied by shocks and rapid shock heating of the ambient gas. The wide range of dynamical behavior exhibited by current loops, and the pros and cons of the model are discussed in the context of current loops in the solar corona.

28728 (INIS-BR—1041) Determination of plasma column transverse section in the TBR-1 tokamak. Conde, M.E. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1986. 91p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702305/JAW.

The temporal evolution of plasma column transverse section in the TBR-1 tokamak is determined. The experimental melhod is based on the simulation of toroidal current distribution in plasma by a set of toroidal filaments. The currents in these filaments are determined by minimization of square error between the magnetic field produced by filaments and the field measured into the tokamak vacuum vessel. For the measurement of magnetic field, twenty small magnetic coils were constructed and installated in the region protected by current limiters. The plasma column transverse cross section is determined by poloidal field produced by the currents in filaments. The multipole moments of plasma current distribution and the Λ Shafranov parameter were obtained. (M.C.K.).

28729 (INPE—4159) Experimental model of halo plasma observed in small-aspect FRC plasma. Aso, Y. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Apr 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702395/JAW.

The halo plasma, which is a thin plasma surrounding the Field Reversed Configuration (FRC), was observed in the Staged Theta Pinch-Linear (STP-L) experiment. The experimental results show that the ion flow in the halo plasma increases in opposite directions at the vicinity of the separatrix and at the edge of the halo, when the end effect is reduced by the guide field. This double structure of ion flow may be explained by the proposed model that halo plasma is formed by energetic ions shuttling between the FRC and the open field region, and the numerical results is in a good agreement with the experiment. The proposed model also suggests that the FRC has a good confinement ability for the energetic particles in the plasma does not connect with the discharge tube.

28730 (ITF—86-97) Power-like distributions in plasma and in various statistics problems. Demidenko, N.P.; Karas', V.I.; Moiseev, S.S.; Novikov, V.E.; Chernousenko, V.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702408/JAW.

The plasma processes for which the distribution is a characteristic parameter of a problem is power-like are analysed. The conditions under which such distributions can be realized are elucidated and the consequences possible in such cases are discussed. 17 refs.

28731 (ITF—86-161) Equilibrium distribution functions for limited plasma-molecular systems. Zagorodnij, A.G.; Usenko, A.S.; Yakimenko, I.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 49p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702412/JAW.

Equilibrium distributions of charged and neutral particles in limited plasma-molecular systems with an arbitrary configurations of boundaries are calculated with all multipole expansion terms taken into account. The distributions of free and bound particles in the case of semi-limited systems that have harmonic oscillators or rigidly coupled pairs of charged particles as a molecular subsystem are studied in detail. 39 refs.; 6 figs.

28732 (ITF—87-18) Electromagnetic wave incoherent reflection by a half-space of weakly-ionized plasma with an absorbing boundary. Zagorodnij, A.G.; Usenko, A.S.; Yakimenko, I.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 33p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702413/JAW.

The spectra of incoherent electromagnetic waves reflected by a half-space of weakly ionized plasmas taking into account the charged particle absorptions by a boundary are calculated using the diffusion approximation. The effect of the boundary absorption properties on frequency and angular distributions of the incoherent reflection differential coefficients is studied in detail. 29 refs.; 9 figs.

28733 (ITP—87-12) On plasma stability under anisotropic random electric field influence. Rabich, L.N.; Sosenko, P.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702422/JAW.

The influence of anisotropic random field on plasma stability is studied. The thresholds and instability increments are obtained. The stabilizing influence of frequency missmatch and external magnetic field is pointed out. 2 refs.; 4 figs.

28734 (UNB-FIS—18/87) Note on Lyapunov's stability of nonlinear cold plasma waves in high frequency limit. Aragao, F.R.F.; Schindler, K. (Brasilia Univ. (Brazil). Dept. de Fisica). Sep 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702485/JAW.

The stability theory of Lyapunov is used to investigate the linear stability of Bernstein - Greene - Kruskal equilibria in the cold plasma limit. A suitable Lyapunov functional is found for the case of the high frequency limit, i.e. for unperturbed ions, implying stability.

28735 Resistive evolution of plasmas with imperfect magnetic surfaces. Miller, G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 5, 1133-1141(May 1988).

The theory of resistive evolution of plasmas is extended to include plasmas with imperfect magnetic surfaces, that is, plasmas having magnetic field lines that wander stochastically. In resistive evolution theory the plasma is assumed to be always in mechanical equilibrium and the evolution occurs by allowing the magnetic flux constraints determining the equilibrium to change, which happens on a resistive time scale. In this paper a formalism is created to describe magnetic field line structure in a general way in order to evaluate the field line integrals that are the magnetic flux constraints. The equations expressing evolution of these flux constraints, along with the plasma mechanical equilibrium equations, are a mathematical model that can be solved to determine the evolution of the plasma. An immediate result of this model is that, for plasmas with stochastic magnetic field lines, the current density has a filamentary structure, giving a self-consistent source of the stochasticity. A simple two-field-line model of the reversed field pinch is discussed.

28736 Energy confinement in turbulent fluid plasmas. Bhattacharjee, A.; Hameiri, E. (Department of Applied Physics, Columbia University, New York, New York 10027). *Physics of Fluids;* **31**: No. 5, 1153-1160(May 1988).

Scaling laws for energy confinement in a turbulent plasma dominated by resistive pressure-driven modes are revisited. New scaling laws are obtained under a consistent low-beta approximation, and differ from earlier theories primarily in their dependence on the plasma pressure.

28737 Two- and three-dimensional tokamak equilibrium modifications driven by the localized ponderomotive force of applied radio frequency waves. Myra, J.R. (Science Applications International Corporation, Plasma Research Institute, 1515 Walnut Street, Boulder, Colorado 80302). *Physics of Fluids;* **31**: No. 5, 1190-1201(May 1988).

Large ponderomotive forces can occur when waves in the ion cyclotron range of frequencies (ICRF) are employed in stabilization or high power heating schemes. It is shown that the magnetohydrodynamic (MHD) equilibrium of the plasma is modified when the rf antenna is localized poloidally and/or toroidally. In the two-dimensional (2-D) problem (toroidally uniform rf) a modified Grad—Shafranov equation describes ponderomotively driven magnetic surface distortions. At electric field strengths of interest for ICRF stabilization, the equilibrium distortions are small provided that L/sub rf/<<a and the poloidal localization of the rf is not severe. The character of the 3-D problem (toroidally and poloidally varying rf) depends on whether or not the ponderomotive force couples to rational surfaces within the plasma. For the case without rational surfaces, the 3-D component of the distortions is found to be small by $1/q^2$/sub a/ relative to the 2-D component. In the case where rational surfaces are excited, magnetic islands result. A threshold condition for island overlap determines the rf electric field at which ergodicity may be expected. It is shown that ergodicity of the edge plasma may occur for some cases of interest for heating and stabilization, but should be controllable.

28738 Ion confinement in a simple mirror stabilized by surface line tying. Good, T.N.; Thompson H.R. Jr.; Rynn, N. (Department of Physics, University of California, Irvine, California 92717). *Physics of Fluids;* **31**: No. 5, 1237-1243(May 1988).

Experiments were conducted using a barium plasma in a simple axisymmetric mirror machine that was stabilized against the magnetic curvature-driven interchange mode by surface line tying. Ion cyclotron resonance heating was applied to heat ions, producing a mirror-trapped ion population. The ion-velocity distribution function was diagnosed nonperturbatively by using laser-induced fluorescence techniques. The rf heated distribution was a non-Maxwellian in f/sub I/(v/sub perpendicular/), and a sloshing distribution in f/sub I/(v/sub parallel/). When the plasma source was cut off, the plasma decay was studied to determine the confinement properties of the plasma afterglow and the effects of the stabilizing blanket. Mirror-trapped ions were lost axially at the classical ion—ion collision rate. Analysis of the temporal evolution of radial profiles of ion-energy density, in the afterglow, indicates that axial loss rates dominanted over radial losses.

28739 Magnetic field line ergodicity in the edge plasma due to an ion-Bernstein wave antenna. Myra, J.R. (Science Applications International Corporation, Plasma Research Institute, 1515 Walnut Street, Boulder, Colorado 80302). *Physics of Fluids;* **31**: No. 5, 1293-1295(May 1988).

Large ponderomotive forces can occur near a high-power ion cyclotron range of frequency antenna, particularly for the parallel electric field polarization used to excite ion-Bernstein waves (IBW). The magnetohydrodynamic (MHD) equilibrium of the edge plasma is modified by these forces when the antenna is highly localized poloidally and toroidally. Magnetic islands develop at the edge, near q = m/n, where chemical bondmchemical bond≦πa/w/sub a/ and chemical bondnchemical bond≦πR/l/sub a/, with w/sub a/ and l/sub a/ the width and length of the antenna, respectively. Ergodicity of the magnetic field lines may be expected when the islands overlap. Numerical calculations of the island overlap criteria are presented for two examples relevant to present day (IBW) heating experiments.

28740 Poloidal ion motion during formation of toroidal high beta plasmas. Antoniades, J.A.; Goldenbaum, G.C.; Weber, B.V. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physics of Fluids;* **31**: No. 5, 1244-1248(May 1988).

Spectroscopic measurements of the ion motion in a fast compression high beta tokamak experiment show paramagnetic ion motion. This motion is initially caused by magnetic field gradient drift, which does not produce any net paramagnetic current opposing the plasma diamagnetic current. After the crowbar of the fast rising toroidal magnetic field a larger paramagnetic polarization drift develops, which contributes to the disappearance of the diamagnetic well.

28741 Dynamic sheath: Objects coupling to plasmas on electron-plasma-frequency time scales. Borovsky, J.E. (Space Plasma Physics Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 5, 1074-1100(May 1988).

The time-dependent interaction between solid objects and the unmagnetized plasmas in which they are immersed is investigated. To this end over 1900 high-resolution, one-dimensional particle-in-cell simulations of the plasmas surrounding cylindrical and planar objects are statistically analyzed. Numerical shot noise produces an electron-plasma-frequency ringing in the simulations, the amplitude of which is related to the plasma temperature and to the numerical system temperature. Whenever the potential of an object is rapidly biased, the surrounding plasma rings with a large amplitude at the electron-plasma frequency. During this ringing, a depletion layer forms around the object on ion-acoustic time scales. Positively charged objects discharge via plasma currents in about tau/sub p// sub e/ /4 and negatively charged objects discharge in about tau/ sub p//sub i/ . Owing to charge separations in the plasmas, for the first few ion-plasma periods after a perturbation, the potential of an object is not directly related to the charge on it. The electron-plasma-frequency ringing drives large-amplitude Langmuir waves, which energize electrons and drive cavitation in the plasma. The fluxes of electrons reaching the objects are bursty at ω/sub p//sub e/, and the energies of the ions striking the object slowly and systematically vary with time.

28742 Simulations of electrically polarized gravitational condensations in a grain plasma. Gisler, G.R.; Wollman, E.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 5, 1101-1104(May 1988).

The two long-range forces in nature, gravitation and electromagnetism, are generally not jointly important in determining the dynamics of physical systems. There is, however, a case in which equilibrium large-scale electrostatic and gravitational forces can be similar in magnitude. In a two-component plasma, in which the massive species is a charged grain with charge-to-mass ratio of order (G)/sup 1/2/, self-gravitation and thermalization result in strong electrical polarization since the oppositely charged low-mass component has a scale height much greater than that of the grains. Preliminary results of a computer simulation of this behavior are presented here. Properties of steady-state gravitational condensations in grain plasmas have been studied with a one-dimensional particle-in-cell code, and an investigation of the ratio of electrostatic to gravitational energy for various values of the grain charge-to-mass ratio has been performed. As expected, this ratio is maximized when the grain charge-to-mass ratio is approximately (G)/sup 1/2/.

28743 Dependence of heat pulse propagation on transport mechanisms: Consequences of nonconstant transport coefficients. Gentle, K.W. (Fusion Research Center, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **31**: No. 5, 1105-1110(May 1988).

The transport coefficients for particles and heat will certainly depend upon plasma parameters. Besides making the equilibrium equations nonlinear, this introduces a multitude of new terms in the set of linearized equations, which can be used to describe the effects of perturbations to the system. A general set of such equations is obtained that includes most physical dependences of the transport coefficients. If transport is driven by gradients in density or temperature, as would be expected from most turbulence theories, significant quantitative effects result. Perturbations no longer evolve at the equilibrium transport rates, and the density and temperature perturbations can be strongly coupled. Results are presented for several specific cases.

28744 Energy transport equations for toroidal plasmas. Shaing, K.C.; Nakamura, Y.; Wakatani, M. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **31**: No. 5, 1288-1290(May 1988).

The differences in the energy transport equations for tokamaks and stellarators associated with Γ/sub r/E/sub r/ are discussed, where Γ/sub r/ is the radial particle flux and E/sub r/ is the radial electric field. The energy exchange quantities are evaluated in terms of poloidal plasma flow, pressure gradient, and E/sub r/. It is found that for stellarators the radial flux Γ/sub r/ in Γ/sub r/E/sub r/ should be Γ/sub r/ = Γ/sub na/, the nonaxisymmetric flux, instead of the total particle flux.

28745 Rayleigh—Taylor instability in ablatively accelerated targets with 1, 1/2 , and 1/4 μm laser light. Emery, M.H.; Dahlburg, J.P.; Gardner, J.H. (Laboratory for Computational Physics and Fluid Dynamics, Naval Research Laboratory, Washington, D.C. 20375-5000). *Physics of Fluids;* **31**: No. 5, 1007-1016(May 1988).

The results of a series of detailed numerical simulations of the Rayleigh—Taylor instability in laser ablatively accelerated targets are presented for a fairly wide range of initial conditions. It is shown that the Rayleigh—Taylor growth rate in an ablative environment is a strong function of the laser wavelength. For perturbation wavelengths about three times the in-flight target thickness, the ratios of the numerical growth rates to the classical growth rates are of the order of 1/1.5, 1/2.5, and 1/3.5 for 1, 1/2 , and 1/4 μm laser light, respectively. The numerical results are in good agreement with the theoretical model presented here based on the ablative convection of vorticity away from the unstable ablation front. These results provide strong evidence for the viability of high-aspect-ratio shells in direct-drive laser fusion.

28746 Nonlinear dynamics of tearing modes in the reversed field pinch. Holmes, J.A.; Carreras, B.A.; Diamond, P.H.; Lynch, V.E. (Oak Ridge National Laboratory, P. O. Box Y, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **31**: No. 5, 1166-1179(May 1988). Contract AC05-84OR21400.

The results of investigations of nonlinear tearing-mode dynamics in reversed field pinch plasmas are described. The linear instabilities have poloidal mode number m = 1 and toroidal mode numbers 10approx. <napprox. <20, and the resonant surfaces are therefore in the plasma core. The nonlinear dynamics result in dual cascade processes. The first process is a rapid m = 1 spectral broadening toward high n, with a simultaneous spreading of magnetic turbulence radially outward toward the field-reversal surface. Global m = 0 perturbations, which are driven to large amplitudes by the m = 1 instabilities, in turn trigger the m = 1 spectral broadening by back coupling to the higher n. The second process is a cascade toward large m and is mediated by m = 2 modes. The m = 2 perturbations have the structure of localized, driven current sheets and nonlinearly stabilize the m = 1 modes by transferring m = 1 energy to small-scale dissipation. The calculated spectrum has many of the qualitative features observed in experiments.

28747 Momentum and thermal transport in neutral-beam-heated tokamaks. Mattor, N.; Diamond, P.H. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **31**: No. 5, 1180-1189(May 1988).

The relation between momentum and thermal transport in neutral-beam-heated tokamaks with subsonic toroidal rotation velocity has been investigated. A theory of diffusive momentum transport driven by ion-temperature-gradient-driven turbulence (eta/sub i/ turbulence) is presented. In addition, the level of eta/sub i/ turbulence is enhanced by radially sheared toroidal rotation. The resulting ion shear viscosity is chi/sub phi/ = $1.3\{(1+\text{eta/sub i/})/\text{tau}+[(\text{L/sub n//2c/sub s/})(dV_\theta/dr)]^2\}^2(\text{rho}^2\text{/sub s/c/sub s//L/sub s/})$. The associated ion thermal diffusivity, chi/sub i/, is identical to chi/sub phi/. Thus a scenario based on velocity-shear-enhanced eta/sub i/ turbulence is consistent with the experimentally observed relationship between thermal and momentum confinement.

28748 Nonlinear evolution of the internal kink mode in toroidal geometry for shaped tokamak plasmas. Holmes, J.A.; Carreras, B.A.; Charlton, L.A.; Lynch, V.E.; Hastie, R.J.; Hender, T.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **31**: No. 5, 1202-1216(May 1988). Contract AC05-84OR21400.

The nonlinear evolution of the internal kink mode is studied in toroidal geometry for noncircular cross-section tokamak plasmas. The study is focused on very low-shear and hollow q profiles, with q(rho)≧1 for which the internal kink is unstable in the latter case,

even at $\beta = 0$. The nonlinear evolution is dominated by ideal magnetohydrodynamics (MHD), and the instability saturates, giving a quasihelical shift to the magnetic axis. The nonlinear saturation is caused by increased field line bending. Time scales of 10^3 tau/sub H//sub p/ and axis shifts of 20% are reached when changes in q on the order of 3×10^{-3} from the marginal profile are produced.

28749 Stability of low-shear tokamaks. Waelbroeck, F.L.; Hazeltine, R.D. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **31**: No. 5, 1217-1223(May 1988).

It has been suggested that the recently observed fast sawtooth crashes are caused by a low-shear, pressure-driven ideal instability. This hypothesis is investigated, using asymptotic methods to solve the toroidal mode equations for a class of equilibria characterized by a low-shear central region in which q-1 is small, separated from the wall by a region with finite shear. A dispersion relation that differs significantly from previous results is obtained. An explicit expression for the growth rate is given for a model q profile.

28750 Self-focusing and filamentation of laser light in high Z plasmas. Jones, R.D.; Mead, W.C.; Coggeshall, S.V.; Aldrich, C.H.; Norton, J.L.; Pollak, G.D.; Wallace, J.M. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 5, 1249-1272(May 1988).

Self-focusing and filamentation of short wavelength laser light in high Z plasmas of interest to laser fusion are discussed. It is found that self-focusing behavior is very dependent on the details of the characteristics of the laser beam, the plasma conditions, and the energy transport processes. Laser light absorption and self-focusing are strongly competitive processes. At. 0.26 μm wavelength the collisional absorption is often so great that there is no intensity amplification of the beam despite the fact that strong self-focusing is present. Wide variations are found in laser light penetration, affected by several factors. Diverging optics reduce the likelihood of self-focusing. Large scale length density gradients have little effect on focusing behavior. The self-focusing behavior is very dependent on beam shape. Large scale hot spots can have a significant effect on whole beam self-focusing early in the pulse. The behavior of small scale hot spots can be qualitatively different than the standard picture. The calculations indicate that small scale hot spots do not achieve a steady state in some cases. Sound waves cause chaotic interactions among neighboring hot spots. It is found that sub-beam size structures are also generated when nonlocal thermodynamic equilibrium (non-LTE) radiation and atomic physics are used in the calculations. The nature of the heat flux and thermoelectric magnetic field generation are examined with a kinetic model. Stimulated Raman backscattering levels in self-focused light are significantly reduced for short wavelengths and high Z plasmas Landau damping plays an important role in determining the Raman levels. Implications for suprathermal electron production, symmetric illumination, x-ray conversion efficiency, and laser light absorption are discussed.

28751 Dispersion relations for the lower hybrid frequency range. Cho, S.; Swanson, D.G. (Department of Physics, Auburn University, Auburn, Alabama 36849). *Physics of Fluids;* **31**: No. 5, 1123-1129(May 1988).

The hot plasma electrostatic dispersion relation for the lower hybrid frequency range has been cast into a form without any sums using the method of steepest descents. This new form of the dispersion relation with the exact resonance term, which is valid for general complex wavenumber and each term of which is identified according to its role of representing physical waves, is shown to be accurate and to be reducible to an expression obtained by Brambilla [Plasma Phys. 18, 699 (1976)] when some approximations are taken. A very simple dispersion relation is also obtained without singular terms near the high ion cyclotron harmonics that are encountered by lower hybrid waves propagating in inhomogeneous magnetic fields. Finally, the damping rate in space is numerically calculated using the equation derived and compared with the result from the unmagnetized ion dispersion relation.

28752 Relativistic magnetosonic solitons with reflected particles in electron--positron plasmas. Alsop, D.;Arons, J. (Department of Physics, University of California at Berkeley, Berkeley, California 94720 and Institute of Geophysics and Planetary Physics, University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids;* **31**: No. 4, 839-847(Apr 1988). Contract W-7405-ENG-48.

The presence of magnetically reflected particles is shown to allow the existence of large amplitude magnetosonic solitary waves in relativistic electron--positron plasmas. If the flow is assumed to contain a single loop of gyrating particles, self-consistent structures are found with peak field amplitudes (B/B/sub ∞/)/sub max/ <(11)/sup 1/2/, where B/sub ∞/ is the magnitude of the upstream magnetic field. In contrast, without reflected particles, the amplitude of a relativistic magnetosonic soliton is restricted to (B/B/sub ∞/) -1<2/γ/sub ∞/, where γ/sub ∞/ is the upstream Lorentz factor. Therefore, if γ/sub ∞/>>1, reflected particles greatly increase the allowable amplitudes of these nonlinear waves. It is also shown that when γ/sub ∞/>>1, the wave properties are independent of γ/sub ∞/, and are completely parametrized by the ratio of the Poynting flux to the kinetic energy flux in the upstream flow. Some new features of solitary waves without reflected particles are also derived, and a heuristic model is presented which gives a simple physical interpretation of many of these results.

28753 Particle diffusion in a spheromak. Meyerhofer, D.D.;Levinton, F.M.;Yamada, M. (Princeton Plasma Physics Laboratory, Princeton University, James Forrestal Campus, Princeton, New Jersey 08544). *Physical Review Letters;* **60**: No. 10, 933-936(7 Mar 1988). Contract AC02-76CH03073.

The local carbon particle diffusion coefficient was measured in the Proto S-1/C spheromak with use of a test-particle injection scheme. When the plasma was not in a force-free Taylor state, and when there were pressure gradients in the plasma, the particle diffusion was 5 times that predicted by Bohm and was consistent with collisional drift-wave diffusion. The diffusion appears to be driven by correlations of the fluctuating electric field and density. During the decay of the discharge when the plasma was in the Taylor state, the diffusion coefficient of the carbon was classical.

28754 A simple model for flashboard plasma expansion. Colombant, D.G.; Weber, B.V. (Plasma Physics Div., Naval Research Lab., Washington, DC 20375 (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 6, 741-746(Dec 1987).

A simple model for flashboard plasma expansion is presented. It is based on the j x B force and the fact that only a fraction α of the total current flows through the expanding plasma. For the parameters under consideration, maximum velocities are roughly proportional to α and reach 70 cm/μs for $\alpha = 1$. B-field profiles from the model are compared with experiment.

28755 Suprathermal electron transport and self-generated magnetic field in laser-target interaction. Kim, K.;Choe, W. (Univ. of Illinois, Urbana-Champaign (USA)). pp v of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Recent laser-target experiment at laser intensities greater than 10/sup 14/W/cm/sup 2/ have reported the occurrence of a gigantic laser driven return current (– 1 MA) from a small target (≦ 1cm/sup 2/ x1mm) with current rising time less than – 1 ns. These results generate optimism for the prospects of achieving ultrastrong magnetic fields of up to 10/sup 3/ T as well as extremely intensive power pulses, and opening up a new era for the scientific areas such as thermonuclear confinement, solid state physics, and many other critical technologies. A strong toroidal magnetic field is produced in laser-target interaction by a rapid expansion of suprathermal electrons. The toroidal magnetic field is calculated self-consistently. In this calculation, the motion of suprathermal electrons emitted at radii the beam axis is calculated exactly, and the motion

of the electrons at radii away from the beam axis is approximated by a guiding center model.

28756 Nonlinear current systems and instabilities in magnetized plasmas. Stenzel, R.L.;Urrutia, J.M. (Dept. of Physics, Univ. of California, Los Angeles, CA 90024 (USA)). pp v of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The behavior of current systems in collisionless magnetoplasmas is of great interest in both basic plasma physics and in various plasma applications in space, fusion and technology. It is usually assumed that the classical tensor conductivity determines the current density J = Σ/sub =/ . E along and across the field B-vector/sub o/ between two electrodes. However, little is known about the self-consistent electric field distribution [E(r,t)] and about nonlinearities in the conductivity [Σ(J)]. An experiment has been performed to study carefully the properties of current flows in a large magnetized afterglow plasma (n/sub e/ ≃ 10/sup 11/ cm/sup -3/, B/sub o/ = 30G, kT/sub e/ ≃ 2eV, 1m l B/sub o/, 2m parallel B/sub o/). The novel aspect of this experiment is the capability to measure the entire vector field of the total current density J(r,t) = del x B/μ/sub o/ from repeated time and space resolved magnetic probe data (~5000 spatial positions, 1024 time steps).

28757 MHD stability and control for mirror machines. Kang, B. Berkeley, CA; Univ. of California (1986). 122p. University Microfilms Order No. 87-18,035.

Thesis (Ph. D.).

MHD stability properties of magnetic mirrors are examined theoretically. A second-order differential equation, governing the resistive ballooning-mode instability for an arbitrary plasma beta, is derived from a set of fluid equations. The resistive effects on the Berkeley 10-m multiple Mirror Experiment (MMX) stabilized by a conducting wall, cusps, and quadrupoles are numerically examined and compared with the know experimental results. Numerical results show that the resistive effects play a dominant role on the low-temperature MMX. The possibility of feedback stabilization of the m = 1 flute mode for axisymmetric mirror machines is also considered. A three-region plasma model is developed and analyzed, consisting of a hot-core surrounded by a warm-transition annulus, which in turn is surrounded by a warm-halo annulus that is in contact with the feedback plates at the two endwalls. By a proper choice of feedback function, the m = 1 flute mode on the core plasma is stabilized by feedback signals applied to segmented, ring-shaped feedback plates. For the axisymmetric MMX, TMX-U, and MFTF-B, the required feedback power and its scaling with plasma parameters are calculated. Results show that stability can be achieved in the MMX and TMX-U devices with a modest feedback gain and power. The power requirement for MFTF-B is more severe, but can be reduced by a modified choice of plasma parameters.

28758 Dynamics of runaway electrons in magnetized plasmas. Moghaddam-Taaheri, E. College Park, MD; Univ. of Maryland (1986). 280p. University Microfilms Order No. 87-12,258.

Thesis (Ph. D.).

The evolution of a runaway electron tail driven by a subcritical dc electric field in a magnetized plasma is studied numerically using a quasi-linear numerical code (2-D in v- and k-space) based on the Ritz-Galerkin method and finite elements. Three different regimes in the evolution of the runaway tail depending on the strength of the dc electric field and the ratio of plasma to gyrofrequency, were found. The tail can be (a) stable and the electrons are accelerated to large parallel velocities, (b) unstable to the Cerenkov resonance due to the formation of a positive slope on the runaway tail, (c) unstable to the anomalous Doppler resonance instability driven by the large velocity anisotropy in the tail. Once an instability is triggered (Cerenkov or anomalous Doppler resonance) the tail relaxes into an isotropic distribution resulting in less acceleration. The synchrotron emission of the runaway electrons shows large enhancement in the radiation level at the high-frequency end of the spectrum during the pitch-angle scattering of the fast particles. The results are relevant to recent experimental data from the Princeton Large Torus (PLT) during current-drive experiments and to the microwave bursts observed during solar flares.

28759 Space-time statistics of the turbulence in the PRETEXT and TEXT tokamak edge plasmas. Levinson, S.J. Austin, TX; Univ. of Texas (1986). 128p. University Microfilms Order No. 87-06,060.

Thesis (Ph. D.).

A study of the statistical space-time properties of the turbulence observed in the edge regions of the PRETEXT and the TEXT tokamaks are reported. Computer estimates of the particle-transport spectrum T(omega), and of the local wavenumber-frequency spectra S(K,omega) for poloidal (k/sub y/) and toroidal (k/sub z/) wavenumbers was determined. A conventional fast-Fourier-transform technique is used initially for the analyses of the potential and density fluctuations obtained from spatially fixed Langmuir-probe pairs. Measurements of the fluctuation-induced particle transport revealed that the particle flux is outward for both PRETEXT and TEXT, and it results primarily from the low-frequency, long-wavelength components of the turbulence. The S(K/sub y/, omega) spectra are dominated by low frequencies (<200 kHz) and small wavenumbers (<4 cm^{-1}) and appear broadened about an approximately linear statistical dispersion relation, anti k(omega). The broadening is characterized by a spectral width sigma/sub k/ (omega) (rms deviation about anti k(omega)). In PRETEXT, sigma/sub k/(omega) is of the order of anti k(omega), and the turbulence appears to propagate poloidally with an apparent mean phase velocity of 1-2 x 10^5 cm/s in the ion diamagnetic drift direction. In TEXT, a reversal in the phase velocity of the turbulence in the edge plasma was observed.

7002 Fusion Power Plant Technology

REFER ALSO TO CITATION(S) 27737, 27999, 28000, 28648

28760 (IAE—4464/7) Study of stationary H/sup -/ ion source performance. Antipov, S.P.; Elizarov, L.I.; Martynov, M.I.; Chesnokov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702236/JAW.

The design of a gas discharge source of hydrogen negative ions with radial magnetic field and cesium hollow cathode is given. The source providing an H/sup -/ ion beam of 1-10 A intensity is designed for studying controlled thermonuclear fusion. The results of study of local characteristics of a plasma in the source, as well as the results of mass-spectrometric analysis of its component composition are presented. On the basis of the measurements the conclusion is made about the principal mechanism of H/sup -/ ion generation in the source. 10 refs.; 8 figs.; 2 tabs.

28761 (IC—87/69) Interaction of intense ion beams with super-range planar targets. Piriz, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702240/JAW.

The dynamics of a metallic plane slab heated by an intense ion beam with range smaller than the slab thickness is described by means of a simple model. The model takes into account the thermal and kinetic energies of the region absorbing the beam energy and the kinetic energy of the unheated part of the slab, the payload. The model yields the temporal behavior of the hydrodynamic efficiency and its dependence on the ratio between the payload and the absorber masses such as is observed in simulation results. (author). 16 refs, 4 figs.

28762 Experimental results from SHIVA Star vacuum inductive store/plasma flow switch driven implosions. Degnan, J.H.; Baker, W.L.; Hackett, K.E.; Hall, D.J.; Holmes, J.L.; Kriebel, J.B.; Price, D.W.; Reinovsky, R.E.; Graham, J.D.; Lopez, E.A. (Plasma Physics Branch, Air Force Weapons Lab., Kirtland AFB, NM 87117-6008 (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 6, 760-765(Dec 1987).

Using a 1313-μF, 3-nH, 120-kV, 9.4-MJ SHIVA Star capacitor bank, the authors performed vacuum inductive store/plasma flow switch (PFS) driven implosions of low mass (200-400 μg/cm/sup 2/) cylindrical foil liners of 2-cm height and 5-cm radius. This technique employs a coaxial discharge through a plasma armature, which stores magnetic energy over 3-4 μs and rapidly switches it to an imploding load as the plasma armature exits the coaxial fun muzzle. The current transferred to the load by the PFS has a rise time of less than 0.2 μs. With 5-MJ stored energy, we have driven fast liner implosions with a current of over 9 MA, obtaining an isotropic equivalent 2.7-TW 0.5-MJ X-ray yield.

28763 Review of plasma flow switch development. Turchi, P.J.; Alme, M.L.; Bird, G.; Boyer, C.N.; Coffey, S.K.; Conte, D.; Davis, J.F. III; Seiler, S.W. (R and D Associates, Washington Research Lab., Alexandria, VA 22314 (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 6, 747-759(Dec 1987).

The plasma flow switch utilizes the nonlinear and non-uniform dynamics of a plasma discharge in vacuum to accumulate magnetic energy in times of several microseconds and then release this energy to a load in times of a few hundred nanoseconds. Experiments have been performed with capacitor banks up to 6 MJ, providing currents in excess of 10/sup 7/ A and peak voltages over 0.5 MV. Theoretical models include simple slug dynamics coupled to lumped-circuit analyses, magnetoacoustic considerations of one- and two-dimensional aspects of the plasma flow, and two-dimensional magnetohydrodynamic code calculations. The present article reviews both experimental and theoretical efforts, discusses the use of the plasma flow switch to drive plasma liner implosions and high-energy ion flows, and indicates directions for plasma flow switch applications to very high current, high-energy inductive pulsed power systems.

28764 The ion beam opening switch. Greenly, J.B.; Rondeau, G.D.; Sheldon, H.T.; Dreike, P.L. (Lab. of Plasma Studies, Cornell Univ., Ithaca, NY 14850 (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 6, 735-740(Dec 1987).

Plasma opening switches (POS's) have shown excellent characteristics in pulsed power applications. Proposed POS scaling predicts that the fastest opening time for a given conducted current should occur using a high-velocity low-density plasma as the switch medium. The ion beam opening switch (IBOS) uses a charge-neutral ion beam of 100-300 kV, ≦ 120 A/cm/sup 2/ as the switch "plasma". Its velocity of up to 600 cm/μs and density of — 10/sup 12//cm/sup 3/ make this a very fast low-density plasma compared with typical 10 cm/μs and 10/sup 13//cm/sup 3/ POS plasmas. The IBOS has conducted ≧ 70 kA flowing in a parallel-plate transmission line driven by a 4-Ω pulser. IBOS opening time is load dependent, being ≦4 ns into a 15-nH load and about twice as long into a 4-Ω electron diode load. However, switch impedance is not zero during the entire conduction time, rising to ≧ 3 Ω by the time of peak current. Peak current conducted before opening does not vary linearly with either injected ion current or switch axial length. Instead, the conduction current scales with plasma density in the switch, and is nearly independent of switch area until the area is restricted to a narrow (— 1 cm) strip. In this experimental geometry, replacing the IBOS with a standard POS gave essentially identical behavior, except first, an order of magnitude less injected flux was required to conduct a given current with the POS than with IBOS, corresponding to similar injected plasma densities for the two types of switches; second, clear evidence of J X B motion of the POS plasma was seen, while none was evident with IBOS.

28765 Experiment to demonstrate the use of a spheromak as an energy transfer medium. Henins, I.;Fernandez, J.C.;Jarboe, T.R.;Knox, S.O.;Marklin, G.J.;Platts, D.L. (Los Alamos National Lab. (USA)). pp v of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The authors propose to experimentally assess the potential of using spheromaks to transfer energy from large, slow moving metal walls to much smaller, faster moving, less massive walls so as to achieve large velocity gains. The spheromaks are bounded by closed metal walls (flux conserver) that, for the time scale of the experiment, contain and shape the magnetic structure. The j x B forces on the eddy currents in the walls provide the acceleration that results in the high velocities. Although the conductivity of a plasma can be quite high, finite resistivity effects limit the useful helicity lifetime, tau/sub K/, of the configuration. It is important to experimentally verify the plasma physics in this new application. Specifically, want to know how tau/sub K/ varies, and whether the minimum energy principle predicts the form of the configuration as the flux conserver geometry is changed. They plan to assess this in two stages.

28766 Monte Carlo simulation of electron motion in crossed rf and magnetic fields. Li, Y.M.;Pitchford, L.C. (GTE Labs. Inc., Waltham, MA 02254 (USA)). pp v of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Measurements of ionization and excitation rate coefficients at very high values of E/N, the ratio of the electric field strength to the neutral density, are often complicated by the presence of electrodes and the associated boundary effects. A recent experiment at Sandia National Laboratories has measured ionization rate coefficients in nitrogen up to 12 kTd (1 kTd = 10/sup 3/Td = 10/sup -14/ V cm/sup 2/), eliminating the complications of boundaries by using microwave excitation at electron cyclotron frequency. The results were interpreted in terms of an effective DC field. The authors performed comparative Monte Carlo calculations of the electron energy distribution and the resulting ionization rate coefficient using both an effective field (DC) and the full time-dependent microwave and constant magnetic field (MW). They show that in the limit of high frequency (or low pressure) and for isotropic scattering that the DC model is valid.

28767 Laser enhanced attachment in diffuse discharges. Giesselmann, M.;Pashaie, B.;Kristiansen, M.;Schaefer, G. (Dept. of Electrical Engineering, Texas Tech Univ., Lubbock, TX 79409-4439 (USA)). pp v of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Measurements of the effect of laser enhanced attachment on externally sustained diffuse discharges are reported. Optical control of diffuse discharges is a promising way of upgrading the performance of e-beam controlled opening switches for repetitive operation. Ideal gases should exhibit a negligible attachment cross section for low E/N values (switch closed) in the ground state and strong attaching properties upon optical excitation in an E/N range between the conducting state and self breakdown of the switch. The ratio of resistivity change in these experiments is much higher than in previous investigations. In this investigation the attachment rate of an electronegative gas component, representing approximately 1% of the gas in the discharge volume, was increased by means of vibrational excitation with a pulsed IR-laser beam. Molecules exhibiting a strongly increased attachment rate upon IR-excitation are vinyl-chloride, vinyl flouride and trifluoroethylene, which has been verified in preliminary experiments. All experiments reported were performed with vinyl chloride and trifluoroethylene.

28768 **Designing the Cascade inertial confinement fusion reactor.** Pitts, J.H. (Lawrence Livermore National Lab., Univ. of California (USA)). pp 175-180 of Structural mechanics in reactor technology. Wittmann, F.H. Accord, MA; A.A. Balkema Publishers (1987). (CONF-870812—). Contract W-7405-ENG-48.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The authors predict that the Cascade ICF power plant concept will produce electricity at a cost of only $0.034/kW.h, which is 70% of an equivalent coal-fired power plant or 90% of a modern pressurized-water-reactor power plant. The net plant efficiency of Cascade is 49%. In addition to producing cost effective electricity, Cascade also has the advantage of low activation and low tritium inventory, and it is inherently safe. The design method outlined here complies with the intent of the American Society of Mechanical Engineers pressure vessel code. Fatigue on the Cascade reactor wall is insignificant because the flowing ceramic-granule blanket does not propagate shock waves. The authors' laboratory scale experiments prove that the Cascade blanket concept is viable. They used the velocity profiles obtained from these experiments to optimize the blanket design.

28769 **Structural features of the Compact Ignition Tokamak.** Citrolo, J.; Brown, G.; Rogoff, P. (Princeton Plasma Physics Lab., NJ (USA)). pp 19-24 of Structural mechanics in reactor technology. Wittmann, F.H. Accord, MA; A.A. Balkema Publishers (1987). (CONF-870812—). Contract AC02-76CH03073.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The Compact Ignition Tokamak (CIT) is undergoing preliminary structural design and definitions. It will be relatively inexpensive with ignition capabilities. During the definition phase it was concluded that the TF coil should be assembled from the laminate copper-Inconel plates since copper alone cannot sustain the expected magnetic and thermal loads. An extensive test program is being initiated to investigate the various materials, and their elastic and inelastic response and to develop the constitutive equations required for the selection of design criteria and for the stress analysis of this device. Finite element analysis nonlinear material capabilities are being used to study, predict and correlate the machine behavior.

28770 **Contamination layers on EUV reflectors.** Scott, M.L.; Arendt, P.N.; Cameron, B.J.; Newnam, B. (Los Alamos National Lab., Los Alamos, NM (USA)). pp 156-162 of Soft x-ray optics and technology. Koch, E.E.; Schmahl, G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-861242—).

From International conference on soft X-ray optics and technology; West Berlin, F.R. Germany (8 Dec 1986).

The authors utilized a visible in siut ellipsometer to investigate the growth of oxide surface layers on aluminum and silicon films deposited in an ultra high vacuum (UHV) system. A single molecular layer of oxide forms on the aluminum film surface in 1 hour when exposed to a partial pressure of 2 x 10/sup -8/ Torr of either oxygen or water vapor. The single molecular oxide layer that forms in 4 hours on silicon when exposed to 2.5 x 10/sup -8/ Torr of oxygen is SiO/sub 2/ if the vacuum ion gauges are operating, but it appears to be SiO if these gauges are turned off during the layer formation. The time of formation of these layers is inversely proportional to pressure. The growth rate of the oxide surface layer drops dramatically after formation of this first monolayer on both aluminum and silicon. Other gases, such as methane and carbon monoxide were found to be essentially unreactive with the aluminum film.

28771 **Development of large high-voltage pressure insulators for the Princeton TFTR flexible transmission lines.** Scalise, D.T.; Fong, E.; Haughian, J.; Prechter, R. (Lawrence Berkeley Lab., CA (USA)). pp 868-872 of Application of accelerators in research and industry '86: Proceedings, Part 2. Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). (CONF-861114—Pt.2). Contract AC03-76SF00098.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Specially formulated insulator materials with improved strength and high-voltage properties were developed and used for critical components of the flexible transmission lines to the TFTR neutral beam ion sources. These critical components are plates which support central conductors as they exit the high-voltage power supply and enter the ion source enclosure. Each plate acts both as a high-voltage insulator and as a pressure barrier to the SF_6 insulating gas. The original plate was made of commercial glass-epoxy laminate which limited the plate voltage capacity. The newly developed insulator is made of specially-formulated cycloaliphatic di-epoxide whose isotropic properties exhibit increased arc resistance. It is cast in one piece with skirts which greatly increase the breakdown voltage. This paper discusses the design, fabrication and testing of the new insulator.

99 GENERAL AND MISCELLANEOUS

9901 Management

REFER ALSO TO CITATION(S) 27986, 27987, 27988, 28583, 28584, 28632, 28633, 28634

28772 **(AECL—5004/30) List of publications April 1983 to March 1984.** (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1984. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702206/JAW.

The scientific and technical publications of Atomic Energy of Canada Ltd issued from April 1983 to March 1984 are listed under ten subject categories. Author and report number indexes are provided.

28773 **(INIS-BR—1060) Directions and deviations in the Brazilian nuclear policy.** Leal, M.C. (Instituto Universitario de Pesquisas do Rio de Janeiro (Brazil)). 1982. 190p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702323/JAW.

The emergence of the Brazilian nuclear policy as a subject of interest to the Brazilian society, the conflicts characterizing its formulation and implementation between 1945 and 1958 and the political criteria for executing a Brazilian nuclear program are presented. (M.C.K.).

28774 **(RISO-M—2642) Health Physics Department annual progress report 1 January - 31 December 1986.** (Risoe National Lab., Roskilde (Denmark)). May 1987. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752802/JAW.

The report describes the work of the Healths Physics Department at Risoe during 1986. The activities cover dosimetry, instrumentation, radioecology, risk by nuclear activities and nuclear emergency preparedness. Lists of staff and publications are included. The emphasis in the report has been placed on scientific and contractual work. However, service functions do constitute a substantial work load for the department.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 27904, 27911, 28778

28775 **(AD-A—187725/7/XAB) Learning functions from examples. Interim report.** Natarajan, B.K. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Robotics Inst.). Aug 1987. 19p. (CMU-RI-TR—87-19). NTIS, PC A03/MF A01.

This paper concerns algorithms that learn functions from examples. Functions on strings of a finite alphabet are considered and the notion of dimensionality defined for families of such functions. Using this notion, a theorem is proved identifying the most general conditions under which a family of functions can be efficiently learned from examples. Turning to some familiar families, strong evidence is presented against the existence of efficient algorithms

for learning the regular functions and the polynomial time computable functions, even if the size of the encoding of the function to be learned is given. Our arguments hinge in a new complexity measure--the constraint complexity.

28776 (AD-A—187820/6/XAB) Shared-memory algorithm and proof for the alternative construct in CSP (Communicating Sequential Processes). Technical report. Fujimoto, R.M.; Feng, H.C. (Utah Univ., Salt Lake City (USA). Dept. of Computer Science). 25 Aug 1987. 37p. (UUCS—87-021). NTIS, PC A03/MF A01.

Communicating Sequential Processes (CSP) is a paradigm for communication and synchronization among distributed processes. The alternative constructs is a key feature of CSP that allows nondeterministic selection of one among several possible communicants. Previous algorithms for this construct assume a message-passing architecture and are not appropriate for multiprocessor systems that feature shared memory. This paper describes a distributed algorithm for the alternative construct that exploits the capabilities of a parallel computer with shared memory. The algorithm assumes a generalized version of Hoare's original alternative construct that allows output commands to be included in guards. A correctness proof of the proposed algorithm is presented to show that the algorithm conforms to some safety and liveness criteria. Extensions to allow termination of processes and to ensure fairness in guard selection are also given.

28777 (AD-A—187822/2/XAB) Optimal performance of distributed simulation programs. Technical report. Swope, S.M.; Fujimoto, R.M. (Utah Univ., Salt Lake City (USA). Dept. of Computer Science). 1987. 16p. (UUCS—87-023). NTIS, PC A03/MF A01.

This paper describes a technique to analyze the potential speedup of distributed simulation programs. A distributed simulation strategy is proposed that minimizes execution time through the use of an oracle to control the simulation. Because the strategy relies on an oracle, it cannot be used for practical simulations. However, the strategy facilitates performance evaluations of distributed simulation strategies by providing a useful point of comparison and can be used to determine the suitability of specific applications for implementation on a parallel computer. Based on the proposed strategy, a tool was developed to determine the maximum performance that can be achieved from a distributed simulation program. This paper describes the technique and its use in evaluating the parallelism available in distributed simulators of parallel computer systems.

28778 (AD-A—187956/8/XAB) Schwarz splitting and template operators. Doctoral thesis. Tang, W.P. (Stanford Univ., CA (USA). Center for Large Scale Scientific Computation). Jul 1987. 39p. (CLASSIC—87-3). NTIS, PC A03/MF A01.

Schwarz alternating method (SAM)is an old mathematical technique dating from 1869. It was commonly believed that SAM was a useful tool for theoretical analysis but not a very practical approach for computations. The earlier experiences showed that SAM converged slowly. In this thesis, SAM is reexamined and generalized. The governing factors of convergence of SAM are explored through the analysis for the model problem. Based on this knowledge, many acceleration schemes can be combined with SAM to yield a new type of iterative method for large sparse-matrix problems. In particular, when these techniques are applied to the solution of the model problem, an optimal complexity can be achieved. Some generalizations of SAM, namely Schwarz splittings (SS), are presented here. For many important applications, such as performing parallel computations in a non-shared memory environment, using composite grids and also applying fast solvers in an irregular region, (SS)s are found to be useful techniques. In order to identify the types of problems for which (SS)s are most suitable, a new structure for the linear operators called template operators has been developed. Some decay results for the elements of the inverses of sparse operators are given. These results provide a theoretical basis for determining when these SS techniques can be used successfully.

28779 (AD-A—188142/4/XAB) Implementing dynamic arrays: a challenge for high-performance machines. Mago, G.; Partain, W. (North Carolina Univ., Chapel Hill (USA). Dept. of Computer Science). 1986. 3p. NTIS, PC A02/MF A01.

There is an increasing need for high-performance AI machines. What is unusual about AI is that its programs are typically dynamic in the way their execution unfolds and in the data structures they use. AI therefore needs machines that are late-binding. Multiprocessors are often held out as the answer to AI's computing requirements. However, most success with multiprocessing has come from exploiting numerical computations' basic data structure - the static array (as in FORTRAN). A static array's structure does not change, so its elements (and the processing on them) may be readily distributed. In AI, the ability to change and manipulate the structure of data is paramount; hence, the pre-eminence of the LISP list. Unfortunately, the traditional pointer-based list has serious drawbacks for distributed processing. The dynamic array is a data structure that allows random access to its elements (like static arrays) yet whose structure - size and dimensions - can be easily changed, i.e., bound and re-bound at run - time. It combines the flexibility that AI requires with the potential for high performance through parallel operation. A machine's implementation of dynamic arrays gives a good insight into its potential usefulness for AI applications. Therefore, the authors outline the implementation of dynamic arrays on a machine that we are developing.

28780 (AD-A—188196/0/XAB) Allocation of data-base files across parallel stores for efficient processing of partial-match queries. Formal report, January-May 1987. Bestul, T.; Jajodia, S. (Naval Research Lab., Washington, DC (USA)). 27 Oct 1987. 12p. (NRL—9084). NTIS, PC A03/MF A01.

This report presents the results of research on the allocation of binary cartesian product data-base files across several stores (such as disks) which are accessible in parallel so that the average time required to perform the retrieval (by using several parallel accesses) of all buckets specified by a partial-match query is objective of constructing efficient packings of Hamming spheres in hypercubes. The viewpoint of binary cartesian product file allocation thus produced allowed in the research the creation of allocations for two particular sizes of the set of stores such that the average processing time for partial-match queries was smaller than that of the best allocation technique found in the literature for these same two cases. It also provides a framework in which good allocations for other particular sizes of the set of stores, and possibly for general sets of stores, might be found.

28781 (AD-A—188206/7/XAB) Measurement and analysis of memory conflicts on vector multiprocessors. Interim report. Calahan, D.A.; Bailey, D.H. (Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science). 1 Oct 1987. 36p. NTIS, PC A03/MF A01.

The memory organization and technological design parameters that create memory access conflicts and affect performance of the CRAY family of processors are studied. Measurements on the dynamic-memory CRAY-2 system are presented.

28782 (AD-A—188499/8/XAB) Laboratory facility for research in parallel computation: project final report. Final report, 31 July 1986-30 July 1987. Gannon, D. (Indiana Univ., Bloomington (USA). Dept. of Computer Science). Jul 1987. 42p. NTIS, PC A03/MF A01.

This DOD URIP effort provided resources for the purchase of a BBN Butterfly parallel-processor architecture for research into parallel processing. The equipment has been used to develop parallel algorithms for ray-traced computer graphics, for numerical fast Fourier Transform (FFT) algorithms, and AI and expert system applications. Papers produced include such titles as Distributed Genetric Algorithms, and A Software Tool for Building Supercomputer Applications.

28783 (AD-A—188500/3/XAB) Primal - dual parallel solution of very large sparse linear programs. Final report, 30 July 1986-29 June 1987. Mangasarian, O.L. (Wisconsin Univ., Madison (USA). Dept. of Computer Sciences). 17 Sep 1987. 6p. NTIS, PC A02/MF A01.

The principal area of this research was the solution of very large sparse linear programs and linear-complementarity problems by successive overrelaxation (SOR) methods. Another important ingredient of the research was the parallelization of the SOR methods as well as other classical methods such as the simplex method for linear programming and Lemke's method for the linear-complementarity problem. A major contribution of the research was the solution of one of the largest general linear programs ever attempted on a workstation (or in fact on a mainframe). A linear program with 500,000 variables, 125,000 constraints and 1,125,000 nonzero matrix elements was solved in less than 72 hours on one of the Micro Vax II computers. Another significant achievement of the research has been the parallelization of the SOR methods with speedup efficiencies sometimes exceeding 100%. The Micro Vax II's were used to test simulations of the parallel SOR algorithms before their implementation on multicomputers and multiprocessors.

28784 (AD-A—188574/8/XAB) Parallelism in the execution of a routine-knowledge rule system on the BUTTERFLY (trademark) computer. Technical report. Boulanger, A. (BBN Labs., Inc., Cambridge, MA (USA)). Dec 1986. 34p. (BBN—6436). NTIS, PC A03/MF A01.

This project ported a routine-knowledge rule system to the BUTTERFLY multiprocessor. The goal was to explore parallelization techniques with an existing rule system originally written for serial execution. The rule system was rewritten to introduce parallelism, and run on a single processor to establish a benchmark for serial operation. The same version, with parallelism enabled, was then run on a 16-node BUTTERFLY multiprocessor. The metering tools on the BUTTERFLY were used to display task behavior and processor utilization. The information gained from these displays was used to guide further experimentation with the granularity of the rules and with the system code to investigate bottlenecks that were lengthening execution time. The project demonstrated that parallelization of routine-knowledge rule systems can yield substantial speedup. It also demonstrated that the metering tools on the BUTTERFLY can be used to achieve additional speedup of parallel implementations. The implications of this research are discussed and compared to the findings of research at Carnegie-Mellon University on parallelizing production systems.

28785 (AD-A—188613/4/XAB) MultiRPC: a parallel remote-procedure call mechanism. Interim report. Satyanarayanan, M.; Siegel, E.H. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Computer Science). Dec 1987. 38p. (CMU-CS—87-136-A). NTIS, PC A03/MF A01.

MultiRPC is an invocation mechanism that enables a client to access multiple servers in a single remote-procedure call. Parallelism is obtained from concurrency of processing on servers and from the overlapping of retransmissions and timeouts. Each of the parallel calls retains the semantics and functionality of the underlying remote procedure call mechanism. These include secure, authenticated communication and the use of application-specific side effects. The underlying communication medium does not have to support multicast of broadcast transmission. This paper describes the design and evolution of MultiRPC, focusing on the issues of runtime efficiency, versatility, and ease of use. The authors derive an analytic model of the system and present experimental results that validate this model. They also present their observations on using MultiRPC to contact up to 100 servers in parallel.

28786 (AD-A—188619/1/XAB) ARCTIC - programmer's manual and tutorial. Interim report. Rubine, D.; Dannenberg, R. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Computer Science). Dec 1987. 30p. (CMU-CS—87-110). NTIS, PC A03/MF A01.

ARCTIC is a programming language for describing real-time systems with many concurrent activities. Unlike conventional languages that model concurrency as multiple sequential threads of control, ARCTIC models concurrency as multiple functions of time, whose domains may overlap. This radical departure from convention has many advantages, including a declarative programming style, implicit synchronization, convenient specification of timing relationships, and an integrated approach to event-driven and data-driven real-time computation. This document is a specification of the ARCTIC language. Examples are included in the hope that this specification may be also used as a tutorial. Details of a preliminary implementation of ARCTIC are given in the appendix.

28787 (AD-A—188620/9/XAB) Characterizing Kripke structures in temporal logic. Interim report. Browne, M.C.; Clarke, E.M.; Grumberg, O. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Computer Science). Dec 1987. 23p. (CMU-CS—87-104). NTIS, PC A03/MF A01.

The question of whether branching-time temporal logic or linear-time temporal logic is best for reasoning about concurrent programs is one of the most-controversial issues in logics of programs. Concurrent programs are usually modeled by labelled state-transition graphs in which some state is designated as the initial state. For historical reasons such graphs are called Kripke structures. In linear temporal logic, operators are provided for describing events along a single time path (i.e., along a single path in a Kripke structure). In a branching-time logic, the temporal operators quantify over the futures that are possible from a given state (i.e., over the possible paths that lead from a state). It is well known that the two types of temporal logic have different expressive powers. Linear temporal logic, for example, can express certain fairness properties that cannot be expressed in branching-time temporal logic. On the other hand, certain practical decision problems like model checking are easier for branching-time temporal logic than for linear temporal logic. This paper provides further insight on which type of logic is best. It is shown that if two finite Kripke structures can be distinguished by some formula that contains both branching-time and linear-time operators, then the structures can be distinguished by a formula that contains only branching-time operators. Specifically, it is shown that if two finite Kripke structures can be distinguished by some formula of the logic CTL (i.e., if there is some CTL formula that is true in one but not in the other), then they can be distinguished by some formula of the logic CTL.

28788 (AD-A—188654/8/XAB) Emulation tool for simulating matrix operations on an SIMD (Single Instruction Stream Multiple Data Stream) multiprocessor. Final report, 15 August 1984-14 August 1987. Martin, H.L. (North Carolina Agricultural and Technical State Univ., Greensboro (USA). Dept. of Electrical Engineering). Oct 1987. 135p. NTIS, PC A07/MF A01.

The MJH1 is a very good software tool to use in the analysis of the correctness of various partitioning algorithms. It has the potential to be a forerunner in the discipline of Computer Engineering at North Carolina A & T State University. This is possible because the emulator is easily adaptable to fit system architectures other than SIMD. Through simulation, different architectures can be implemented, as well as various algorithms for exclusive partitioning of matrices to perform simple matrix operations in a parallel or multiprocessor environment. The MJH1 Emulator has the potential to be expanded tremendously. The instruction set could grow immensely. Also, the emulator could be made into a smarter, more-intelligent machine by combining some existing commands and making its language of a higher level.

28789 (AD-A—188708/2/XAB) Alpha-structure-based B-HIVE multicomputer. Wike, W.B.; Miller, T.K.; Agrawal, D.P. (North Carolina State Univ., Raleigh (USA). Dept. of Electrical and Computer Engineering). 1987. 8p. NTIS, PC A02/MF A01.

Pub. in SIAM, 265-270(1987).

This paper describes the design and implementation of the B-HIVE multicomputer, a 24-node generalized hypercube being constructed at North Carolina State University. Each node in B-HIVE consists of a pair of tightly coupled microcomputers: a National Semiconductor DB32016 processor with MMU and FPU to serve as the application processor, and an Intel 80186 processor to handle intra-nodal communications. Intra-nodal communications is via dual ported RAM. The hardware is designed to primarily support packet switched communications between nodes, but also have the capability to support a limited number of dynamically configurable

circuit switched channels, as well. A demand-driven virtual-paging mechanism was incorporated into the design to provide internodal communications which is transparent to the application software. More direct message passing via system call is supported as well.

28790 (BNL—40820) The construction of preconditioners for elliptic problems by substructuring, IV. Bramble, J.H.;Pasciak, J.E.;Schatz, A.H. (Cornell Univ., Ithaca, NY (USA); Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 27p.

We consider the problem of solving the algebraic system of equations which result from the discretization of elliptic boundary value problems defined on three dimensional Euclidean space. We develop preconditioners for such systems based on substructuring (also known as domain decomposition). The resulting algorithms are well suited to emerging parallel computing architectures. We describe two techniques for developing these precondictioners. A theory for the analysis of the condition number for the resulting preconditioned system is given and the results of supporting numerical experiments are presented. 16 refs., 2 tabs.

28791 (UCRL—97887) Library software in supercomputing environment. Durst, M.J. (Lawrence Livermore National Lab., CA (USA)). 17 Nov 1987. Contract W-7405-ENG-48. 10p. (CONF-8711166—1).

From Conference on the interface between statistics and computer science; Philadelphia, PA, USA (17 Nov 1987).

While the status and nature of supercomputer is quite well known in the physical science communities (Devreese and Van Camp, 1985), the statistical community is only slightly involved in the use of supercomputers. Most computing statisticians have settled into a comfortable world: S on workstations, SAS on mainframes. For statisticians, this is the well-lit parlor of computing;I propose here to shine a flashlight around the back alley. I will first define supercomputers and describe the supercomputing environment. This material will make necessary some information on why anyone would use supercomputers. I will then describe the principal sources of (scientific) library software on supercomputers and discuss their advantages and disadvantages. Next, some comparison timings will show what is brought by moving to a supercomputer, vectorizing, and further optimization. I will close with a harangue on future directions for statistical computing on supercomputers. 33 refs., 1 tab.

28792 Computing motion using analog and binary resistive networks. Hutchinson, J.; Koch, C.; Luo, J.; Mead, C. (Thinking Machines Corp. (US)). *Computer;* **21**: No. 3, 52-64(Mar 1988).

To the authors, and other biological organisms, vision seems effortless. The authors open their eyes and they "see" the world in all its color, brightness, and movement. Flies, frogs, cats, and humans can all equally well perceive a rapidly changing environment and act on it. Yet, they have great difficulties when trying to endow the machines with similar abilities. In this article, they describe recent developments in the theory of early vision that led from the formulation of the motion problem as an ill-posed one to its solution by minimizing certain "cost" functions. These cost or energy functions can be mapped onto simple analog and digital resistive networks. Thus, they can compute the optical flow by injecting currents into resistive networks and recording the resulting stationary voltage distribution at each node. These networks, which they implemented in complementary metal oxide semiconductor (CMOS) very large scale integrated (VLSI) circuits, represent plausible candidates for biological vision systems.

28793 Computing environments for data analysis III: Programming environments. McDonald, J.A.; Pedersen, J. (Dept. of Statistics, Univ. of Washington, Seattle, WA 98195 (US)). *SIAM Journal on Scientific and Statistical Computing;* **9**: No. 2, 380-400(Mar 1988).

This is the third in a series of papers on aspects of modern computing environments that are relevant to statistical data analysis. In this paper the authors discuss programming environments. In particular, they argue that integrated programming environments (for example, Lisp and Smalltalk environments) are more appropriate as a base for data analysis than conventional operating systems (for example, Unix).

28794 An evaluation of sorting algorithms for common-bus local networks. Mikkilineni, K.P.; Su, S.Y.W. (Honeywell Inc., Corporate Systems Development Div., 1000 Boone Avenue North, Golden Valley, MN 55427 (US)). *Journal of Parallel and Distributed Computing;* **5**: No. 1, 59-81(Feb 1988).

Evaluating the performance of local area networks is a major concern of the research community and organizations that install this type of network. In data processing applications, sorting is one of the most important and frequently performed operations, because database operations can be performed efficiently on sorted files. The efficiency of sorting algorithms in local networks, therefore, plays a significant role in determining overall network performance. This paper evaluates four alternate methods of performing external sort in common-bus local networks. Each method has five steps: interrupt and synchronization, network data transfer by packets, local sorting global sorting, and output. The execution time for each method is calculated for four cases using different overlaps among the time components. Each method is evaluated by observing its behavior at different network speeds, file sizes, network sizes, page size, I/O times, and interrupt and synchronization times. This paper shows how changing the value of these variables affects the performance of the sorting algorithms. These observations are useful in designing sorting algorithms and other general, parallel algorithms for common-bus local networks.

28795 (SAND—87-1343-Vol.11-No.2, pp 2-9) Optical-fiber communication network for the future. Dec 1987. NTIS, PC A03/MF A01. Order Number DE88005955/JAW.

In Sandia technology: Volume 11, No. 2.

Computing at Sandia has grown with the expanding use of central mainframe computers. Their early communication network consisted of a tree-structured, twisted-pair cable arrangement connecting a small number of remote terminals with the central computing facility (CCF) through underground conduits. The first element of their present network, a Gandalf port contender was installed in 1979 to connect the rapidly expanding number of users with the limited number of host ports at the CCF. However, with computer use changing to interactive processing and because of Sandia's classified information requirements, the existing network was approaching saturation by 1981. Thus, installations of the primary 144-fiber trunk system of their very high-capacity wide-ranging optical-fiber cable and communication network was begun that year and will soon be completed in a loop 2.6 miles in circumference. This communication utility will make access by terminal to computers as easy as plugging in electrical appliances or making a phone call. Requirements and installation of the system are described. 7 figures.

28796 (PB—88-148846/XAB) Hardware support of parallel asynchronous processes. Varshavsky, V.I.; Marakhovsky, V.B.; Peschansky, V.A.; Rosenblum, L.Y.; Tsirlin, B.S. (Helsinki Univ. of Technology, Otaniemi (Finland)). 1987. Trans. of unidentified mono., 235p by G. Pulkkis and J. Yloenen. 245p. NTIS, PC E09/MF A01.

The papers are a collection of lecture notes presented in 1982/83 at Helsinki University of Technology. The whole study reviewed in these lectures aims at the major goal of the synthesis of computing and control circuits.

9903 Information Handling

REFER ALSO TO CITATION(S) 27528, 28135, 28582, 28779, 28780, 28795

28797 (AD-A—188352/9/XAB) Prototype for remotely shared textual workspaces. Abdel-Wahab, H.M.; Guan, S.U.; Nievergelt, J. (North Carolina Univ., Chapel Hill (USA). Dept. of Computer Science). 1987. 26p. NTIS, PC A03/MF A01.

Computer-based collaboration between geographically dispersed users is still limited primarily to electronic mail and file transfer, but there is increasing interest in computer support for real-time interaction between remote users. The problem of imple-

menting remotely shared workspaces, which allow users to operate simultaneously on the same objects, is of broad interest. Our objective is to show textual workspaces that allow real-time collaboration can be implemented efficiently by using existing operating systems and communications primitives. This paper documents our experiences in implementing a prototype under Berkeley UNIX, using the programming language C, and Berkeley Interprocess Communication facilities. The authors describe design alternatives that take into account the communications bandwidth between the different sites of the network, and they introduce an efficient protocol that regulates user access to the shared workspace.

28798 **(RAL—88-003) User guide to HEPDATA - the Durham/RAL HEP databases - on the RAL CMS system.** Whalley, M.R.; Roberts, R.G. (Durham Univ. (UK). Dept. of Physics). (Rutherford Appleton Lab., Chilton (UK)). Jan 1988. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753099/JAW.

This document provides comprehensive instructions on how to use the HEP-DATA databases on the CMS system at RAL. The databases available are Reaction Data, Particle Properties, Experiments, and the SLAC preprint (PPF/PPA) compilation from 1980 to the present, fully updated with publication information.

9905 Civilian Defense

28799 **(PB—88-157649/XAB) Protection of society against chemical weapons: care and attendance for nerve gas injuries.** Olgus, M.; Persson, S.A.; Sellstroem, A.; Szabo, C. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1987. 110p. (In Swedish). (FOA-C—10298-1.2). NTIS, PC E05/MF A01.

The analysis concerns problems of care and attendance for people injured by nerve gas. Civil defense and war-time medical attendance functions are analyzed, and measures that can improve these functions are presented. Suggestions concerning minimum demands that should be placed upon such functions are discussed.

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